C. PROJECT ORGANIZATION AND PARTNER RESPONSIBILITIES

The entity responsible for environmental concerns on the Sea Launch Program is the Sea Launch Limited Partnership (SLLP) acting through its General Partner, the Sea Launch Limited Duration Company (LDC). Both the SLLP and the Sea Launch LDC are organized under the laws of the Cayman Islands, B.W. I. The SLLP is responsible for the development work and for entering into launch contracts with customers and performing those contracts. The address and telephone number of the Sea Launch Limited Partnership, the Sea Launch LDC, and the Launch Platform Limited Partnership are:

Sea Launch Company, LDC
Windward I, Safehaven Corporate Centre West Bay Road
P.O. box 10168 APO
Grand Cayman, Cayman Islands British West Indies

phone: 1-345-945-8390

fax : 1-345-945-8388

There are four companies involved in this venture:

1. Boeing Commercial Space Company
2. Kværner Maritime a.s
3. KB Yuzhnoye
4. RSC Energia

The LDC is the General Partner of the SLLP and will perform under The Company Law (Revised) of the Cayman Islands. The LDC will issue contracts with the Partners for the development work on behalf of the SLLP.

The principal responsibilities of each company are illustrated in Figure C-1. A short description of each company's responsibility follows this introductory section.

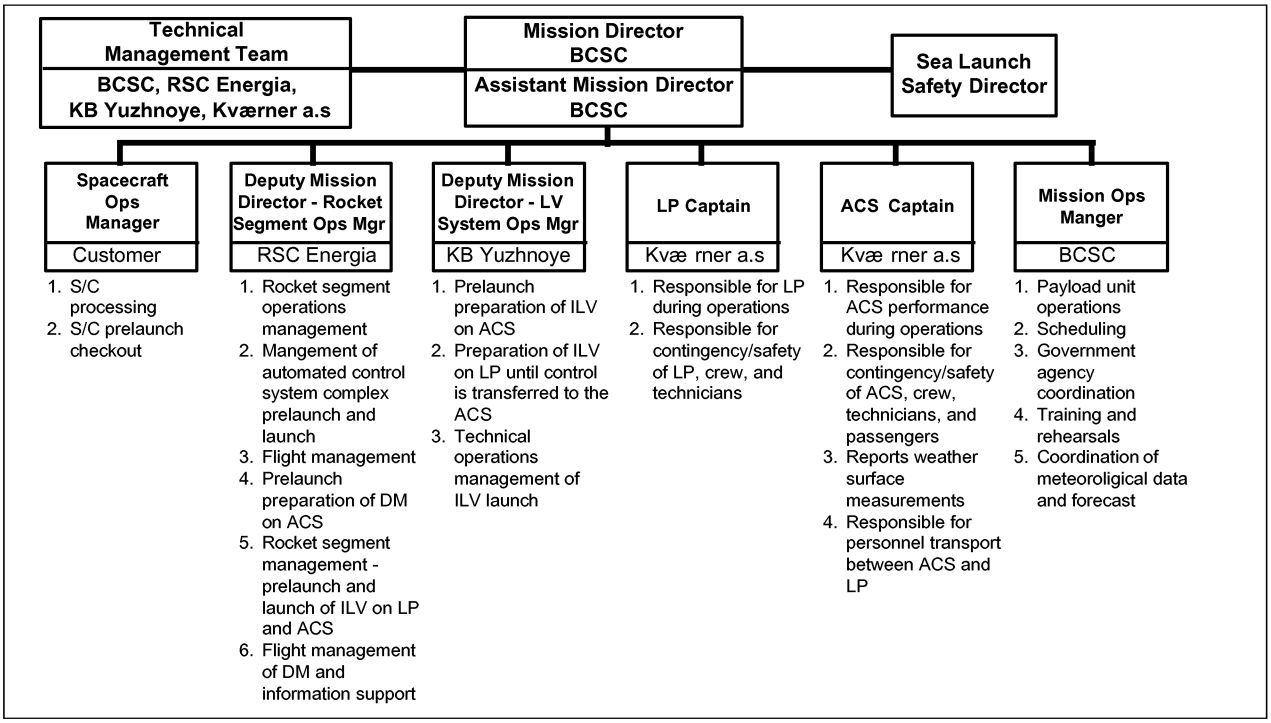

Figure C-1. Mission Operations Team

All launches will be licensed through the Office of the Associate Administrator for Commercial Space Transportation (AST), an office within the Department of Transportation's (DOT) Federal Aviation Administration (FAA). Sea Launch is marketing its services to United States and international spacecraft manufacturers. The Sea Launch payloads will be communication, navigation, or remote sensing satellites. Payloads will be licensed by appropriate U.S. agencies and/or foreign countries. Registration of space objects is required by United Nations, Article IV of 1975 Convention on Registration of Objects Launched into Outer Space. The process Sea Launch has established for payload registration begins 60 days before launch with notification to AST. Thirty days before launch, Sea Launch will notify U.S. Space Command (USSC), 1st Command and Control Squadron, Combat Analysis Code J30XY, of the initial orbit parameters, points of contact, launch vehicle description, launch vehicle size, and description of object(s) to be orbited. On launch day, USSC will be notified that the launch has occurred. Within 30 days of the launch, AST will be provided with the international designator, date and location of launch, orbital parameters, and general information of the space object(s). For U.S.-owned payloads, AST transfers this information to the State Department, which notifies the United Nations within five months. The process is not yet determined for non-U.S.-owned payloads.

C.1 BOEING COMMERCIAL SPACE COMPANY

Boeing Commercial Space Company (BCSC) has the responsibility for project management, will submit the launch license application data package to AST, and will plan the missions and interface with the customer and/or spacecraft manufacturer. In addition, BCSC will develop and manufacture the payload fairing (PLF), the payload adapter (PLA), and will develop the Home Port (HP). The development of the HP includes environmental analysis sufficient to satisfy all government jurisdictions (i.e., California governmental agencies, the City of Long Beach, the Port of Long Beach, local fire departments, and the U.S. Coast Guard). Also, BCSC will operate the HP and market the Sea Launch Venture. During the operational phase, BCSC will lead the Mission Operations Team.

C.2 KVÆRNER MARITIME A.S

Kværner Maritime a.s is constructing the assembly & command ship (ACS), refurbishing the launch platform (LP), and will manage all maritime activities including all environmental analysis for maritime activities. During operational phase, Kværner will contract to operate the ACS and the LP.

The ACS Limited Partnership has entered into a contract with Kværner for building the ACS and for providing the ship to the LDC. In addition, it is responsible for related maritime planning, licensing, and operations.

The LP Limited Partnership has entered into a contract with Kværner for building the LP, providing the vessel to the LDC, and providing planning, licensing, and operations related to the LP.

C.3 KB YUZHNOYE

KB Yuzhnoye will modify and manufacture the Zenit's first and second stage hardware and software in order to meet new requirements levied by Sea Launch customers. During the operational phase, Yuzhnoye will support launch activities associated with the Zenit and associated Zenit ground support equipment. In particular, Yuzhnoye will support the pre-launch preparation of the integrated launch vehicle (ILV) on the ACS and the preparation of the ILV on the LP until control is transferred to the ACS during the countdown phase.

C.4 RSC ENERGIA

RSC Energia is modifying and manufacturing the Block DM-SL upper stage hardware and software in order to meet new requirements levied by Sea Launch customers. In addition, Energia will install all launch vehicle vessel support equipment. During the operational phase, Energia will support launch activities and in particular will:

1. Manage the rocket segment operations.
2. Manage the automated control system complex during pre-launch and launch.
3. Manage the flight segment.
4. Execute the pre-launch preparation of the Block DM-SL on the AC.
5. Manage the rocket segment pre-launch and launch activities onboard the LP and ACS.
6. Manage the information support function during the flight of the Block DM-SL.
7. Manage the range assets including the ground stations in Russia.

D.1 GLOSSARY

accretion	Gradual buildup of land or seafloor formed by magma rising to the surface along some tectonic plate boundaries.
anaerobic	Absence of oxygen.
annelids	Multi-segmented, worm-like animals.
ascent groundtrack	The projection, on the surface of the earth, of the launch vehicle flight path from liftoff until orbit insertion.
benthic	Pertaining to or found at or on the sediment-water interface of a large body of water.
biomass	The dry weight of living matter present in a species or ecosystem population for a given habitat area or volume.
boundary layer	The lowest portion of the atmosphere where the frictional effects of the earth's surface are substantial.
Coriolis force	Inertial momentum causing deflection of a moving object relative to the earth's surface; objects moving north and south of the equator are deflected to the right and left respectively.
demersal	Living at or near the bottom of the sea.
echinoderms	Demersal marine organisms with an internal skeleton and a system for flushing water through the body to permit movement, respiration, nourishment, and perception.
ecosystem	A conceptual view describing the interrelationships, including the flow of materials and energy, between living and non-living features of a natural community.
exclusive economic zone	An offshore boundary, usually set at 320 km, establishing a nation's economic sovereignty over the resources present within that perimeter.
food chain	Scheme for describing feeding relationships by trophic levels among the members of a biological community.
habitat	The physical environment in which a plant or animal lives.
instantaneous impact point	The point on the surface of the earth where an airborne mass would strike without atmospheric (e.g., wind) or continuing propulsive effects; the area containing impact points is described by impact limit lines.
ionosphere	That part of the earth's upper atmosphere which is ionized by solar ultraviolet radiation so that the concentration of free electrons affects the

	propagation of radio waves.
mass balance	The accounting of all energy and/or matter that is in flux between or stable within subdivisions of a physical process or ecosystem.
mesosphere	That part of the earth's atmosphere above the stratosphere characterized by a temperature that generally decreases with altitude.
ozone	A form of oxygen, O_3, naturally found in the ozonosphere within the stratosphere.
phytoplankton	Passively floating or weakly self-propelled aquatic plant life.
primary productivity	New organic matter produced by plant life.
stratosphere	That part of the earth's atmosphere between the troposphere and the mesosphere in which the temperature increases with altitude.
tectonics	Movement and deformation of the earth's surface caused by fluid circulation beneath the surface.
thermosphere	That part of the earth's atmosphere extending from the top of the mesosphere to outer space, including the exosphere and ionosphere, marked by more or less steadily increasing temperatures with altitude.
trophic level	A broad grouping of organisms within an ecosystem defined as being in the same tier in the food chain hierarchy; most generally, the first trophic level is the photosynthetic plants, the second is the herbivores, and the third is the carnivores.
troposphere	That part of the atmosphere extending from the earth's surface to an altitude of 10 to 20 km, in which the temperature generally decreases with altitude.
upwelling	The process by which water rises from a deeper to a shallower depth; may be caused by a variety of physical phenomena.
zooplankton	Passively floating or weakly self-propelled aquatic animal life.

D.2 UNIT CONVERSION TABLE

Length

1 km (kilometer)	=	0.621 mile
1 m (meter)	=	3.28 feet
1 cm (centimeter)	=	0.394 inch
1 mm (millimeter)	=	0.0394 inch
1 µm (micron)	=	0.0000394 inch

Mass

1 kg (kilogram)	=	2.20 pounds
1 g (gram)	=	0.0353 ounce
1 mg (milligram)	=	0.0000353 ounce

Energy

1 J (joule)	=	0.239 calories

Velocity

1 km/second	=	2,240 miles/h
1 m/second	=	2.24 miles/h

Force

1 N (Newton)	=	0.225 pound (force)
1 kgf (kilogram force)	=	2.205 pound (force)

Volume

1 L (liter)	=	0.26 gallon

Probability (example)

1 in 1 million	=	$1x10^{-6}$
Degree of Latitude	=	Each 15^0 of latitude represents approximately 1,034 miles

Mr. James Seger

Comment 1

- "The proposed action is an FAA license of "all possible launches by SLLP at the specified launch location." This action is overly broad considering the limited scope of the EA. The EA does not cover all possible launches, it covers only those made with certain launch vehicles. Either the EA must be expanded or the action should be limited to cover only those launch vehicles and other operations specifically analyzed in the EA. Additionally, only those payloads of types and constructed with materials accounted for in the EA should be covered by the proposed action. The payloads are not covered by the EA."

FAA Response: The EA is intended to support an environmental determination on the consideration of a launch operator license including up to six launches per year. This EA would require re-evaluation by FAA to determine whether additional NEPA assessment and documentation is needed if Sea Launch proposed a significant change to the plan it originally submitted to FAA as part of the launch license application. Examples would be a change in the launch location, significant increases in the number of launches, significant changes in the type of payloador any changes in launch trajectory.Sea Launch has indicated it does not foresee any such changes in the near future. Sea Launch also has no intention of using a launch vehicle other than that covered by the EA (EA Section 2.2.1).

Satellite payloads currently manifested by Sea Launch are all common, earth-orbiting data transmission satellites. The environmental effects of these satellites, including possible contamination from a failed mission scenario, have previously been analyzed and determined to be non-significant by FAA in its 1986 Programmatic Environmental Assessment (EA Section 1.3.4). Therefore, the FAA analyzed only unique aspects of the Sea Launch license application for potential environmental significance.

Comment 2

- The finding of no significant impact is fatally flawed because the scope of the environmental assessment arbitrarily excluded consideration of the payload. The document puts forth as a rationale for not considering payloads arguments that have no logical basis. Specifically, it is stated that because the payloads will be fueled and sealed prior to leaving the home port and will not become operational until an altitude of 35,000 km is reached there is no reason for consideration of the possible environmental effects of the payloads. Yet the document includes failed mission scenarios that entail explosion of the launch vehicle at different stages of the launch. A parenthetical statement indicates that the intent is to launch commercial satellites. This description of payload covers any object of any kind that might be launched for commercial purposes (commercial purposes of SLLP or its client). Clearly, there are possible payload contents that may have serious environmental effects if dispersed or ignited by an explosion. The environmental effects of products and residues of the payload are not considered to some extraordinary levels of detail. Yet the possible residues of the payload are not considered for reasons totally unrelated to the possible

involvement of the payload in a failed mission scenario. The fact that the payload is fueled and sealed prior to leaving home port and will not be activated until an altitude of 35,000 km has no bearing or relationship of any kind to the possible environmental effects of the residues of the payload after an explosion of the kind specified in the failed mission scenario. Thus, there is no basis for not considering the payloads as part of the analysis of impacts for the failed mission scenarios. For this reason, the environmental assessment must be considered fatally flawed and thus there is not a sufficient basis for a no significant impact determination. Without a basis for such determination, the determination must be found arbitrary and capricious.

FAA Response: Please see FAA response to Comment 1 and Appendix C, Page C-2, Paragraph One

Government of Ecuador

Comments on the Sea Launch Environmental Assessment were provided by the Government of Ecuador to the FAA via the Embassy of Ecuador, Washington, DC. Individual comments were made by the following Ecuadorian institutions:

- The Navy Oceanographic Institute
- The Ministry of Defense, Office of Maritime Interests
- The Center of Integrated Survey of Natural Resources by Remote Sensors (CLIRSEN)

Comment 1

- The fate and effect of kerosene released on the ocean surface and the risk associated with the rocket's second stage.

FAA Response: With the launch location at 154° West, the furthest east kerosene and stage 2 could fall to the Earth's surface is in the vicinity of 110° West, or roughly 1,900 kilometers from the Galapagos Islands. This statement is based on the fact that by around 135° West, stage 2 has consumed all of its propellant during its ascent. During descent from that point, the stage's eastward momentum would cause the hardware to land at around 110° West.

Thus, the closest distance stage 2 and its kerosene fuel could ever come to the Galapagos Islands is about 1,900 kilometers away. Data now available on the strength properties of stages 1 and 2 and their historical use in the former Soviet Union also indicate that during their descent, the stages are likely to rupture and disintegrate from stresses induced from uncontrolled tumbling. Specifically, the probability of stage 1 remaining intact is low, while stage 2 would always be destroyed during descent. As the stages break up, residual propellants are dispersed at very high altitudes. Fuel dispersed from stages 1 and 2 would evaporate in minutes and within a few thousand feet, as is the case when a pilot lightens a plane by dumping jet fuel. The relatively small amounts of residual kerosene from stage 1 that do make it to the ocean surface will dissipate by evaporation and decomposition within hours (references cited in EA Section 4.3.2.1). Early loss of stage 2 would give a similar result. At the distances involved, the kerosene involved would be of no consequence to Wolf and Darwin Islands. For these reasons, therefore, it was concluded it would be impossible for stages 1 and 2 or their kerosene fuels to have any negative effect on Wolf and Darwin Islands.

Comment 2

- The risk to Wolf and Darwin Islands and the need to assess potential impacts to either island.

FAA Response: The risk of an impact to either island would only occur in a very unlikely event in which stage 3 suffers a particular kind of catastrophic failure during a few particular seconds of its flight (EA Section 4.3.4.2). SLLP selected a more northerly

route to reduce still further the risk to the Galapagos Islands in consideration of their special character.

Before the details of this scenario are discussed, it is useful to consider what is meant by the term "risk". For the launch industry in general, "risk" is a measure based on the chance of some unsafe event occurring, the area potentially affected by the event, and the susceptibility and value of the resources in the area that could be damaged.

Given this, FAA's assessment evaluated risk to Wolf and Darwin Islands in terms of three factors:

- The chance that a stage 3 failure occurs during two specific time intervals of around 250 milliseconds each (0.25 seconds).
- The area on the Earth's surface potentially affected by falling debris.
- The vulnerability of the resources likely to be present in those affected areas.

All components of the rocket are rigorously tested to ensure they are ready for flight. After liftoff, the onboard flight safety computer continuously checks to ensure the rocket is performing as planned. Deviations are automatically corrected and the rocket is returned to the programmed flight plan. A deviation from the flight plan that cannot be corrected results in the rocket's engine being turned off. This type of failure is rare, and when it does occur, other launches are postponed until the reason for the failure is fully identified, understood and corrected.

In addition, and based on historical use, stage 3 failures typically occur either when an engine first starts or near the end of its designed operation time. The time span of relevance to Wolf and Darwin Islands safety is centered between these two periods of engine performance. Failure would have to occur during one of two specific instances in time for stage 3 debris to fall on either island. FAA believes that the probability of a failure occurring at these times is so remote as to pose no basis for concern.

During the type of failure considered above and as is described in EA Section 4.3.4.2, stage 3 and satellite components would return to Earth through the atmosphere at an initial velocity of nearly 6 kilometers per second. Stage 3 and the satellite are largely made of lightweight and fragile materials. As the pieces re-enter the atmosphere, nearly 99% of the material would burn up from exposure to extreme temperature and deceleration forces. Most importantly, all propellants and potentially hazardous materials would burn up at an altitude of 50 kilometers or more. Only very durable pieces of the third stage and spacecraft, such as bolts, fittings, and engine parts made of special metals would survive reentry and reach the surface of the Earth.

After atmospheric reentry, the few remaining pieces – which on average are about 25 centimeters in diameter weighing about 20 kg – would slow to what is called their terminal velocity. As they fall at slower speeds, they would begin to cool in the denser portions of Earth's atmosphere, and they would be differentially scattered based on their

shapes and wind resistance. Due to the relative size and distribution of the land masses in the region, it is most likely the pieces would land harmlessly in deep ocean waters (EA Figure 4.3.4-1). When this happens, the debris pieces would quickly decelerate and sink to the bottom, much as if a rock were thrown into the water. Should pieces hit Wolf or Darwin Islands or their offshore waters, they would hit at a speed as though dropped from an airplane. The result on land is that the pieces may bounce a few times and then come to a stop or, depending on the surface composition, become imbedded a small distance in the ground. In no case would falling debris be hot enough to pose any risk of fire.

Because of their relative size, arid habitat, and great distance to the other, larger Galapagos islands, Wolf and Darwin Islands are less able to support large and stable populations than the clustered, more sizable and popular islands to the south. Thus, it is remotely possible that an individual of a species could be struck by falling debris, but the low density of the Wolf and Darwin ecosystem residents makes this very unlikely.

It has been suggested that it would be useful to study the islands to assess the risk of harm relative to the precise density and distribution of resident populations. Based on available data, however, FAA believes new data on this subject would not change the basic conclusion reached by the current assessment. In effect, the chance of any harm coming to the ecosystems of either island is minimal, and any damage that could possibly occur would not significantly impact the ecosystems present on either island.

In summary, damage to Wolf and Darwin Islands could occur only following an extremely improbable series of events:

- A failure that cannot be corrected by onboard safety systems occurs during two specific time periods of around 250 milliseconds each;
- One or more of a few dozen pieces of debris fall on Wolf or Darwin Island;
- One or more pieces strike and harm flora or fauna on either island; and
- Harm to an individual of a species causes significant harm to the ecological community.

Data and experience available from the conduct of thousands of launches over nearly forty years, and the information available on the environments of Wolf and Darwin Islands, indicate this series of cause-and-effect relationships would not occur.

Comment 3

- The advisability of shifting the launch site further north in order to bypass Wolf and Darwin Islands.

FAA Response: A shift in launch site to the north by itself would not necessarily result Wolf and Darwin Islands being bypassed, because of the effect of inertial forces on the flight of the rocket. The current plan to deviate north of the main island group relies on the rocket's maneuverability. The distance flown to the north of equator would be determined by both the launch point and launch azimuth, which is the angle measured from north that the rocket flies. As a rocket flies further north of the equator, whether as

the result of the launch point or launch azimuth or both, the rocket and satellite consume more fuel in getting to final orbit. The result is that the satellite has a shorter life span in orbit due to the initial use of propellant. Because a reduced satellite life span causes less operating revenue, satellite operators typically want to minimize the deviation from the equator during launch. In the case of Sea Launch, the Sea Launch Company negotiated with its satellite customer to plan the current deviation north of the Galapagos main island group, despite the loss in revenue represented by this change. Further deviation north of Wolf and Darwin Islands, however, would cause a more pronounced loss in orbital energy and, therefore, revenue. FAA believes that the Sea Launch Company and its customer have found an acceptable balance between lost energy and the very small risk regarding Wolf and Darwin Islands.

In effect, a launch from any point in the world requires a trade off of factors. The objective is to conduct a commercial launch that maximizes safety for people and the environment, while remaining viable for the launch operator and satellite operator.

International Legal Obligations of Concern to SPREP

Comment 1

- Articles 5, 6, 9, 10, 14 and 16 and SPREP Dumping Protocol particularly kerosene as an "oil".

FAA Response: The United States is a party to the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP Convention) and the Protocol for the Prevention of Pollution of the South Pacific Region by Dumping (SPREP Protocol). The SPREP Convention is designed to protect the marine environment of the South Pacific Region from a variety of sources of marine pollution. The area covered by the Convention generally encompasses the 200 nautical mile zones of twenty-four states and territories located in the South Pacific Region and the area of the high seas beyond 200 miles that are entirely enclosed by those areas. Article 2(f) of the SPREP Convention defines pollution as "the introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuaries) which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities."

The Sea Launch proposed launch site is outside the SPREP Convention Area, and, under a normal launch scenario, debris from a launch is not anticipated to fall within the SPREP Convention Area. The FAA has, however, conducted an extensive environmental assessment that meets the requirements of Article 16 of the SPREP Convention. The FAA consulted with interested parties on the proposed project and analyzed potential environmental effects of the project. The assessment indicates little, if any, impact on the marine environment. Nevertheless, the FAA has, consistent with the Convention, used best efforts to assure that any effects on the marine environment related to the Sea Launch project are minimized. Through the consultation process, an environmental monitoring program is being developed to aid in assuring that any project effects are kept to a minimum. Additionally, any hindrances to marine activities will be minimized by, among other things, notification to seamen and fishermen of impending launches.

The SPREP Protocol regulates within the Convention Area the deliberate disposal at sea ("dumping") of wastes and other matter. In addition, Article 10 of the SPREP Convention requires Parties, in key part, to "take all appropriate measures to prevent, reduce and control pollution in the Convention Area caused by dumping…" Article 2(b) of the SPREP Convention defines "dumping" for both the SPREP Protocol and the SPREP Convention. That definition is identical to the definition of "dumping" in the London Dumping Convention of 1972. As discussed below, the anticipated rocket discharges are not "dumping" within this definition.

See the separate FAA response to comments from Ecuador on what happens to any kerosene associated with spent rocket stages.

Comment 2

- London Dumping Convention and 1996 Protocol with reference to Precautionary Principle and reverse Listing Process. Not yet in force but indicating current global view.

FAA Response: The United States is a party to the London Dumping Convention (LDC) of 1972. The LDC is intended to prevent pollution of the sea by dumping waste and other matter that is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea. The FAA understands that Sea Launch ships, including the Assembly and Command Ship and Launch Platform ship, will comply with applicable requirements of the LDC.

With respect to discharges of stages and residual kerosene, which are part of the normal operations of rockets regardless of whether the rockets are launched from land or sea, such discharges are not covered by the LDC or by the 1996 Protocol to that Convention. They do not fall within the meaning of "dumping" as that term is defined in Article III, section 1 of the LDC or Article 1, Section 4 of the 1996 protocol. To the best of the FAA's knowledge, the international community shares this view. The FAA understands that such normal operational rocket discharges have not generally been viewed by countries as dumping within the LDC, and that the International Maritime Organization Secretariat has received no country reports indicating that countries have subjected such operational discharges to the LDC regime.

Comment 3

- UNCLOS: Part XII as well as Articles 87, 91 (Liberia) 116-120 conservation of living resources.

FAA Response: The United States is a signatory, though not a party, to the United Nations Convention on the Law of the Sea (UNCLOS). UNCLOS sets forth a comprehensive framework governing uses of the oceans. It allocates jurisdiction, rights and duties among States that carefully balances the interests of States in controlling activities off their own coasts and the interests of all States in protecting freedom to use the ocean spaces without undue interference. It sets forth a comprehensive framework for protecting the marine environment.

Turning to the specific Articles referenced by SPREP, the proposed Sea Launch project appears consistent with Article 87, which expressly provides for freedom of the high seas. Article 91 of UNCLOS states that each vessel will fly the flag of the State in which it is registered. The FAA understands that Sea Launch will comply with this requirement.

Turning now to Articles 116-120 concerning living resources on the high seas and Part XII of UNCLOS, pertaining to protection and preservation of the marine environment. Article 194(1) of UNCLOS, in key part, requires States "to prevent reduce and control pollution of the marine environment … using for this purpose the best practicable means at their disposal and in accordance with their capabilities …" Article 194(2) in key part,

requires States "to take all measures necessary to ensure that activities under their jurisdiction or control are so conducted as not to cause damage by pollution to other States and their environment…" The FAA's actions meet these requirements.

The FAA has conducted a thorough environmental assessment of the Sea Launch project, including assessment of the effects on any resident or migratory species populations. The FAA has also consulted with other governments in the region. Based on the results of this process, the FAA believes that the environmental impact, if any, of the proposed project on the marine environment is nominal. The project is not anticipated to cause damage by pollution to other States and their environment. As discussed in the response to SRPEP Comment on the SPREP Convention above, the FAA has taken steps to minimize any impacts. In addition, if the FAA issues a license for the proposed Sea Launch project to proceed, it will require the implementation by Sea Launch of an environmental monitoring program, subject to approval by the FAA and consultation with SPREP and countries in the South Pacific region. The FAA will use data from this monitoring program to confirm or revisit FAA environmental findings reached as an ongoing part of its environmental review process concerning the proposed Sea Launch project. This is consistent with Article 204 of UNCLOS. The FAA intends to provide data generated from the monitoring program to SPREP and make it available to other interested parties consistent with Article 205 of UNCLOS. Moreover, were the United States Government to become aware of imminent or actual damage to the marine environment, it would notify other States consistent with Article 198 of UNCLOS.

Comment 4

- MARPOL Convention Annex 1 - flushing of fuel lines into ocean after launch. Annex 5 – post-launch debris to be blown into ocean a[s] spent rocket stages.

FAA Response: The United States is a party to the Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships of 1973 as Amended (MARPOL) and Annexes I, II, III and V to MARPOL. The Sea Launch Assembly and Command Ship and the Launch Platform ship are expected to comply with all applicable MARPOL requirements.

With respect to normal debris released by Sea Launch launch vehicles (rockets) after launch, such debris is not covered by MARPOL. MARPOL applies to ships. After lift-off from the Launch Platform ship, Sea Launch rockets and their payloads are not ships within the meaning of MARPOL. The debris released by the Sea Launch rockets is not different than debris released by rockets which are launched from land. To the best of FAA's knowledge, MARPOL has not been interpreted to apply to such rockets. Similarly, MARPOL has not been understood to apply to airplanes.

During normal launch operations of the rockets themselves, there is no flushing of fuel lines into the ocean. During normal launch vehicle ignition, there is no loss of kerosene other than an incidental release of vapors from the fuel connections that dissipates immediately.

In the case of a launch aborted on the Launch Platform ship, resulting in engine shutdown, which probability estimates indicate may be expected to occur roughly only once every 87,000 launches, fuel lines would be automatically uncoupled. Such a shutdown could result in potential release of a total of approximately 70 kg of kerosene (less than 15 gallons) which is the total capacity of the fuel lines. Nearly all of this kerosene would be contained by the structural members of the flame bucket on the Launch Platform ship; however, some portion of this kerosene may leak or splash on to the ocean surface. In the unlikely event that such a release occurs, Sea Launch will follow MARPOL reporting requirements.

Comment 5

- Outer Space Treaty 1967, 1972 Space Liability Convention: on liability for damage.

FAA response: SPREP notes concerns regarding two treaties governing activities in outer space. The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410 (commonly referred to as the Outer Space Treaty) describes the obligations of states party to the treaty. The Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 961 U.N.T.S. 187, establishes liability for damage caused by space objects. The treaty provisions apply as relevant. Also, the financial responsibility requirements of 49 U.S.C. Subtitle IX, ch. 701--Commercial Space Launch Activities apply as well.

Greenpeace Pacific

The following comment codes have been used to address specific concerns addressed in this letter:

Air Quality Impact Comments	Comments A#
Waste Comments	Comments W#
Noise Comments	Comments N#
Biological/ecological Comments	Comments B#
Health and Safety Comments	Comments H#
Threatened and Endangered Species Comments	Comments TE#
Cumulative Impacts Comments	Comments CI#

Comment B1

- "The release of heated freshwater from pre-launch preparations, which would have impact on plankton in the water surrounding the LP."

FAA Response: The freshwater tanks on the Launch Platform hold 27,474 gallons. The FAA estimated that the heat of the rocket exhaust would evaporate approximately 80 percent of this or approximately 21,800 gallons, while the remainder would be dispersed by the force of the exhaust and would settle on a wide area on the ocean surface. Research in the region has documented natural patchiness of plankton densities and inherent variability in naturally-occurring stressors on the surface and also with depth (Yoder, 1995; Murray, 1994; Philander, 1992; and Vaulot, 1995). Any quantification of plankton mortality would therefore necessarily be statistically indeterminate.

Comment B2

- "The release of 4.5 tones of unused kerosene for each launch which would form a surface sheen covering several square kilometers, killing plankton."

FAA Response: Historically, approximately 3,489 kg and 1,060 kg of kerosene, or about 3.9% and 4.7% of total Stage 1 and Stage 2 kerosene respectively, fell unburned in the Zenit fuel tanks. However, given the incentives of launching commercial satellites where each kilogram of payload is critical, the Russian and Ukrainian partners have improved the efficient use of propellants and as a result have reduced the amount of unused kerosene to 2,000 kg in Stage 1 and 450 kg in Stage 2. When the thrust of each stage is terminated and each stage is separated from the remaining rocket, the speed of Stages 1 and 2 would be 2,620 m/s and 6,380 m/s (meters per second), respectively. The control of the guidance system that ensures proper orientation of the hardware would also be terminated for each stage, causing each stage to tumble. The respective speeds and physical forces on each tumbling stage may cause the rupture and release of the remaining propellants in the case of Stage 1 and would ensure break up and release in the case of Stage 2. The FAA expects kerosene releases to occur above 60 km in either case.

Because much of the unused kerosene from Stages 1 and 2 during normal launches would be released at extremely high altitudes, the impact of kerosene on the ocean surface

would be much reduced.. It is therefore appropriate to also consider its effect at high altitudes in the atmosphere.

Research done on the release of fuel from airplanes has shown that jet fuel, which is very similar in chemistry and physical behavior to kerosene, is completely evaporated within about 1,000 meters from the point of release*. (Note: The release of jet fuel is a common action taken by pilots who need to lighten the weight of a plane and shed flammable materials when in potentially dangerous situations.) At the point of release, winds disperse the released liquid over a wide area resulting in a mist. Evaporation of all but the largest droplets then occurs within a few minutes, because evaporation is affected more by droplet size, i.e., the surface area on the drop, than the breakdown with the addition of heat from the atmosphere and sun to the carbon dioxide and water.

* From an analysis performed by The Boeing Company, 1980. This is publicly available through the FAA.

Comment A1

- "The release of 181 tonnes of carbon dioxide (CO_2) in the lower troposphere from each launch."

FAA Response: To place Sea Launch emissions in context, consider the magnitude of other sources of man-made CO_2 in the atmosphere. For example, burning fossil fuels is estimated to place roughly five billion tonnes of CO_2 into the atmosphere each year[1]. The annual emission of CO_2 associated with the rocket launches is approximately 2,200 tonnes, assuming a one-to-one conversion of CO into CO_2. Sea Launch therefore, would contribute less than one-millionth of the effect due to fossil fuel combustion alone. This does not take into account other man-caused and natural sources of greenhouse gases. In summary, the FAA does not consider the emissions impact due to Sea Launch activities to be significant.

Comment A2

- "The release of 36,100 kg [~36 tonnes] of carbon monoxide (CO) into the troposphere."

FAA Response: From EA Table 4.3.2-2, the total release per launch of CO to the entire atmosphere is estimated to be 113 tonnes not the 36 tonnes mentioned in the comment. However, CO is not considered a major greenhouse gas-at least relative to CO_2, CH_4, N_2O, and various halogenated compounds. CO can, however, be oxidized to form CO_2, perhaps the most widely recognized of the greenhouse gases. Sea Launch would constitute less than one-millionth of the effect due to fossil fuel combustion.

Comment A3

- "The release of oxygenated organic compounds. Nitric and nitrous acids would reduce stratospheric ozone levels."

[1] O'Riordan, Timothy. Ed., 1995; Environmental Science for Environmental Management, Longman Group Limited, Essex, England.

FAA Response: Although more research would lead to a greater understanding of the various mechanisms that relate operation of rockets to stratospheric ozone, current research referenced in this EA section 4.3.2.5 indicates the effect of the rocket launching industry on stratospheric ozone is not significant. By extension, the effect of Sea Launch, which does not use the type of chlorine-based rocket fuel most associated with depletion of stratospheric ozone, would not be significant. One aspect of this research is the attempt to compare the impacts of emissions from solid rocket motors, in terms of significance and immediacy, versus those systems using a hydrocarbon fuel and LOX, like the proposed Sea Launch system. There is ongoing research conducted by the U.S. Government concerning the impacts of rocket emissions on stratospheric ozone (RISO Project). This research is under scrutiny by FAA and will be included in consideration for launch licensing environmental determinations once complete, validated and verified.

Comment W1

- "The dumping of spent stages and residual fuels in the ocean. The two rocket stages, weighing 36 tonnes and 11.5 tonnes respectively, and the fairing, weighing 2 tonnes, would fall into the ocean. The rocket stages would have impacts on benthic communities, and the fairing would float creating a maritime hazard."

FAA Response: Regarding debris that falls to the ocean and sinks, FAA believes the surface area of the debris to which the ocean is exposed, and not its collective mass, is a more meaningful measure of impact and risk. Stage 1 will sometimes break up during descent, while Stage 2 will always break up during descent at a high altitude. This process can be described as being similar to the behavior of an egg, which is strong when compressed along its long axis, from point to point, and weak if compressed in the middle. In the same manner, each stage is designed to be very strong when travelling vertically in a straight path, however when stressed side-to-side, the rocket has severely reduced structural strength. In the case of Stage 1 and 2 hardware, each launch results in a maximum impact area of approximately 404 and 127 square meters of ocean surface, respectively. This assumes the tubular shape of the rocket is simply opened and flattened, an approach that would conservatively maximize the potential for falling material to strike something on the surface or contact something on the seafloor.

For any launch, at most only 0.00003% and 0.000001% of the ocean surface in the Stage 1 and Stage 2 impact zones, respectively, would be impacted by falling debris. In the case of the fairing, the maximum size if flattened would be 149 square meters, the fairing deposition area would be 4.712×10^9 square meters, and at most only 0.000003% of the ocean surface would be at risk from impact from fairing debris.

Unlike Stage 1 and 2 pieces, the two halves of the Sea Launch fairing will break up into a number of rigid pieces. Each piece will either float at or below the surface for a number of years, or become waterlogged and sink within a few days. Unlike plastic debris such as fishing nets, rope, string, and packaging materials that readily ensnares or is ingested by sea life, fairing pieces are relatively large, solid sheets of material. As such, floating

fairing pieces will offer resting places for sea birds and provide smaller sea life shade and some protection from predators
In over 40 years of approximately 4,000 orbital rockets being launched from over thirty locations throughout the world, there have been no recorded instances of any impact or damage to ships or boats in areas where stages fall. This is the case despite the fact that these locations are situated in coastal areas characterized by relatively high rates of commercial, subsistence and recreational vessel traffic, and in direct proximity to the diverse and productive ecosystems that are common along many coastlines (e.g., Kennedy Space Center, Florida; Vandenberg AFB, California; Wallops Flight Facility, Virginia; Kagoshima Space Center and Lambda Launch Complex, Japan).

Several months before the first launch, Sea Launch Company intends to work with the Republic of Kiribati and representatives of industrial fishing fleets that operate in the region to coordinate the administrative process by which such notice would be given. All launch operators including Sea Launch Company are required to provide Notices to Mariners and Aviators as a condition of the proposed launch license. When properly coordinated and responded to this notice serves to further ensure safety of the public. No launches would be conducted unless all fishing vessels are clear of the predetermined safety zone surrounding the Launch Platform. Visual and radar sensors will be used to verify this.

Both ship traffic and the concentration of vulnerable marine life are known to be low in that part of the Pacific Ocean (van Trease, 1993) relative to other areas of the world's oceans that have been in the path of rocket launches throughout the world for decades without an incident.

Comment N1

- "No details are available on the effect of noise on maritime life in the vicinity."

FAA Response: Scientific literature, including those cited in the EA, indicates the noise generated by rockets and airplanes overflying marine life causes a startle reaction among mammals, birds, and reptiles that are on shore during the noise event. Louder or more prolonged noise will cause rushed movement into the water. Based on the studies and adaptability of marine life observed at rocket launching sites and airports situated in coastal regions throughout the world, including many tropical environments, there is no indication the marine organisms will be significantly affected by the occasional launches proposed by Sea Launch Company*

*Versar, Inc. *Final Environmental Assessment Vandenberg Air Force Base Atlas II Program.* August 1991.

*National Aeronautics and Space Administration. *Draft Tier I Environmental Assessment*. April 1996.

*ENSR Consulting and Engineering. *Environmental Information in Support of a Request for a Letter of Authorization for the Incidental Harassment of Pinnipeds by the Launches of McDonnell Douglas Aerospace Delta IIs at SLC-2W.* Camarillo: ENSR, July 1995.

*National Aeronautics and Space Administration. *Draft Supplemental Environmental Impact Statement for Sounding Rocket Program.* Washington, August 1994.

*Brown & Root Environmental. *Environmental Assessment of the Kodiak Launch Complex*. Aiken: Brown & Root Environmental, June 1996.

Comment CI 1

- "Cumulative effects over the proposed 20 year program include dumped debris rocket stages and fairings, emissions including greenhouse gases and ozone depleting substances, ocean contamination from kerosene, other fuels and heated water and the mortality of biodiversity including plankton, marine and bird species."

FAA Response: Please see responses to Comments W1, B1, A1, A2.

EA Section 4.3.2.4 indicates tropospheric impacts from Sea Launch rocket launches would be below levels of concern within a few days. With a gap of two or so months between launches and the rapid rate of dispersion of emissions in the troposphere, the effects from one launch would be non-detectable well before the next launch. Similar comments apply to the impacts in the stratosphere (see EA Section 4.3.2.5). The loss of ozone in the exhaust trails is temporary, and normal ozone levels are re-established within several hours to a day or so. With a two month period between launches, the very small loss of stratospheric ozone that may be attributable to a Sea Launch launch would be replaced by the natural generation and migration processes of the atmosphere, and return to natural levels long before the next launch. Research currently underway regarding the impacts of rocket exhaust on stratospheric ozone has indicated this is what normally happens to rocket emissions. However, the research, which is lead by Aerospace Corporation under the program management of Dr. Martin Ross, is on going and additional information will be considered as results are available.

*"Rocket Impacts on Stratospheric Ozone (RISO) Project Results," presented by Dr. Robert R. Bennett, Thiokol Propulsion Group, FAA, Washington, DC, April 8, 1998.

*Ross, M., "Rocket Impacts on Stratospheric Ozone," AIAA Paper 97-0525, Jan. 1997.

*Ross, M., "Local Impact of large Solid Rocket Motor Exhaust on Stratospheric Ozone and Surface Ultraviolet Flux," Journal of Spacecraft and Rockets, Vol. 33, No. 3, 1996, p.435.

Since, as stated above, the effects attributable to any one launch would not be detectable within a few days to a week or so after each launch. FAA has therefore determined there would be no significant cumulative effect over a twenty-year period. This conclusion is consistent with the known effects from launches from fixed space launch facilities (e.g.,

Cape Canaveral AS, FL; Vandenberg AFB, CA; and Kennedy Space Center, FL) in use for decades by the U.S. government. Studies conducted at Kennedy Space Center regarding the cumulative effects of Shuttle launches in terms of both near and far-field impacts on the environment (e.g., toxic effects of HCl or acid rain on vegetation) have shown minimal effects.*

*Schmalzer, P.A., C.R. Hall, C.R. Hinkle, B.W. Duncan, W.M. Knott, and B.R. Summerfield, 1993, "Environmental Monitoring of Space Shuttle Launches a Kennedy Space Center: The First Ten Years," Presented in the 31st Aerospace Sciences Meeting & Exhibit, Reno, NV, American Institute of Aeronautics and Astronautics, Washington, DC.

*Bionetics Corporation, "STS-5 Launch Effects Summary Report," Kennedy Space Center, Florida, KSC-STS-Effects-STS5, July 1983.

*Bionetics Corporation, "STS-32 Launch Effects Summary Report," Prepared for NASA Biomedical Operations and Research Office, Contract No. NAS10-11624. BIO-ENV-007, March 1990.

The relevance of carbon residue resulting from LOX-kerosene combustion is addressed in EA Section 4.3.3 is somewhat overstated because the amount emitted by rocket LOX-kerosene systems is usually considered to be incidental, on the order of a few kilograms, due to the rocket's combustion efficiency. This small quantity of particulate carbon would be readily incorporated into the ocean's carbon cycle (EA Section 3.4).

In regard to the Sea Launch project's threat to planktonic biodiversity, FAA believes that it appropriately considered plankton mortality in terms of its significance to the ecology of the launch area (EA Section 4.3.2). Given that research in the region has documented natural patchiness of plankton densities, any quantification of plankton mortality would necessarily be statistically indeterminate and of limited, if any, value.

Comment B3

- "An unsuccessful ignition attempt would release LOX vapor and kerosene. The failure and explosion of the integrated launch vehicle (ILV) would result in an explosion of the ILV fuels and the distribution of pieces of the LLV and LP around the vicinity. Particulates from the resulting smoke would drift downwind. Plankton and fish would be killed."

FAA Response: Based on the calculation of the Sea Launch partners who have experience with these systems, it is anticipated that an unsuccessful ignition and associated defueling would occur once every 87,000 missions. This is based on Russian and Ukranian reports that kerosene defueling of the Zenit rocket has never been required during an actual launch. FAA concluded that the lost LOX would mix with and be indistinguishable in the atmosphere within minutes from either one or two aborted launches. As described in EA Section 4.3.1, all but roughly 70 kg of kerosene would be returned to the Launch Platform's fuel tanks. The 70 kg of kerosene that would be lost would be released from the fuel lines during the automated uncoupling of the lines. The

LP deck configuration would cause the kerosene to fall to and wet the flame bucket. This structure is a tent-shaped structure, 18 meters long, designed to deflect the rocket's exhaust away from the water surface and in a horizontal direction to the starboard and port sides. This massive structure has numerous structural members that would serve to catch and contain virtually all of the spilled kerosene. While nearly all of the kerosene would be contained, some would likely splash off the deflector and fall into the ocean surface below. Because of safety concerns, no one would be on board the LP during this time, and Sea Launch would not attempt to recover the kerosene inadvertently released should defueling be necessary.

The kerosene lost to the air or ocean surface from defueling would be chemically or biologically broken down into more basic molecules as described in EA Section 4.3.2.1. The small quantity of kerosene released to the environment would cause an impact as described in EA Section 4.3.2.1, but over an area of a few square meters. Impacts from such an event would not be significant or even detectable over time.

Comment H1

- "Human safety concerns include fallout from launches, particularly failed launches, and the effects of kerosene slicks and floating debris on fishing and other vessels."

FAA Response: As with all launches licensed by FAA, notice will be coordinated with various appropriate authorities before each launch to alert those who may be in the area to reduce the risk associated with falling debris. The details of the necessary notification of local fishing boats will be worked out in continuing discussions with the Kiribati government. Comments B3 and CI 1 further addresses the releases of kerosene to the ocean environment.

Comment TE1

- "Potential impacts on rare and endangered species, such as sea turtles and whales, marine mammals and migratory birds, has not been addressed."

FAA Response: The EA states there are no threatened and endangered species that will be impacted by the proposed launch activities. FAA believes the EA accurately and consistently summarizes available data. The wide variety of migratory or highly mobile species that are known to pass through the east and central equatorial Pacific Ocean likely traverse the areas associated with the proposed launch activity. The individuals of these species, however, would not be at risk of significant impact due to their relatively low concentration and transience in those areas, the only occasional presence of the proposed launch activity, and the extremely small area of the ocean affected by the activity.

South Pacific Regional Environment Programme (SPREP)

Comments were sent to Mr. Nikos Himaras, FAA/AST, by Mr. Tamari'l Tutangata, Director of SPREP. The cover letter was dated May 28, 1998.

Background

SPREP is an intergovernmental organization charged by 22 member countries to promote cooperation and support protection and improvement of the Pacific environment, and to ensure its sustainable development. The SPREP Convention, to which the United States is a party, states that any assessment of major projects that could affect the SPREP region's marine environment shall be communicated to SPREP which shall make that assessment available to interested parties.

SPREP is the secretariat for two regional conventions, the Convention for the Protection of the Environment and Natural Resources of the South Pacific Region (the SPREP Convention) and the Convention on Conservation of Nature in the South Pacific (the Apia Convention). SPREP is also the regional secretariat for the Regional Seas Programme of the United Nations Environment Programme.

SPREP Comment Summary

The Sea Launch Company is a joint venture between United States, Ukrainian, Russian, and Norwegian partners. The company is based in Norway and organized under the laws of the Cayman Islands. Its ships are registered in Liberia. It has a homeport in Long Beach California, U.S.A.

According to the Environmental Assessment (EA), Sea Launch proposes to launch commercial satellites from international waters 20 km outside the Exclusive Economic Zone of Kiribati's Christmas Island. The satellites would be launched from a converted semi-submersible oilrig platform using 1980s Ukrainian Zenit rocket stages and a Russian Block DM upper stage. Each launch would emit 36 tons of carbon monoxide (CO) and 118 tons of carbon dioxide (CO_2) into the lower troposphere. The two rocket stages, weighing 36 tons and 11.5 tons respectively, and the streamlined fairing, weighing a total of 2 tons would fall back into the ocean. The rocket stages would sink, but the fairing would float on the surface for an indefinite period of time. Unused fuel — approximately 4.5 tons of kerosene for each launch — would form a kerosene slick several square kilometers wide. The rockets, called launch vehicles, and the satellites, would be carried to the launch site on custom-designed vessels built by the Norwegian partner in the joint venture. The company proposes to launch two satellites in 1998 and then six every year for 20 years.

> ***FAA Response***: The figures referenced by SPREP in the comment above refer to releases of tropospheric CO and total atmospheric CO_2 and should be cited as 36 tonnes and 181 tonnes respectively. Atmospheric emissions are further discussed in the response to Comment A6. Updates to figures cited by SPREP from the EA are

provided in the specific responses below. Regarding the issue of unused kerosene, we note that engine use efficiencies achieved by Sea Launch Company after the EA was drafted indicate that the quantity of unused kerosene remaining in various stage engines would be significantly reduced. In addition, Stage 1 may sometimes be expected to break up during descent, and Stage 2 is always expected to breakup during descent, releasing residual propellants such that much less kerosene would be expected to reach the ocean surface. (See detailed response to Comment B5). We also note that Sea Launch Company now proposes to launch no satellites in 1998 and three satellites in 1999.

Our Associate Administrator for Commercial Space Transportation has proposed an Environmental Finding Document: Finding No Significant Impact for the proposed project based on the EA.

SPREP has been sent a copy of the Sea Launch EA. SPREP is charged by 22 member countries to promote cooperation and support protection and improvement of the Pacific environment, and to ensure its sustainable development. The SPREP Convention, to which the United States is a party, states that any assessment of major projects which could affect the marine environment shall be communicated to SPREP which shall make that assessment available to interested parties. Having studied the EA of the Sea Launch proposal, SPREP has identified several concerns. These have been coded and addressed separately below. The first comments are general in nature; the rest deal with technical environmental issues. The comment codes are:

General Comments	Comments C#
Air Quality impact comments	Comments A#
Waste comments	Comments W#
Noise comments	Comments N#
Biological/ecological comments	Comments B#
Social and Economic comments	Comments S#
Health and Safety comments	Comments H#
Threatened and Endangered Species comments	Comments TE#
Energy Efficiency comments	Comments E#
Environmental Management comments	Comments EM#
Cumulative Impacts comments	Comments CI#
Pacific Policy comments	Comments P#

Comment C1

- There is very little time for comment, or for consultation with SPREP's member countries. Sea Launch customers announced in 1995 (Hughes Aircraft Co; San Jose Mercury News December 19 1995) and 1996 (Space Systems/Loral July 15 1996) that the first Sea Launch liftoff was scheduled for the second half of 1998, yet the Government of Kiribati and SPREP were not informed of the proposal until April 1998. The draft EA arrived at SPREP on April 30, 1998. Detailed comments are due to arrive by post in the office of the Associate Administrator for Commercial Space Transportation no later than May 26, 1998. The short time frame between delivery of

the EA and the deadline for comments permits only minimal consultation between SPREP and its member countries.

FAA Response: It is our understanding that the Republic of Kiribati and SPREP were each provided copies of the draft EA on April 8 and 9, 1998, respectively, during visits by Sea Launch representatives to Kiribati and SPREP offices in Apia, West Samoa. The thirty day comment period is consistent with the time period under U.S. National Environmental Policy Act (NEPA) regulations to accommodate public comments. Sea Launch Company informed us that its first communication with the Government of Kiribati occurred in the Fall of 1997, and that the company regrets it was not able to successfully schedule a visit and provide information on the project at that time. However, we have indicated that we would consider and take into account comments and additional information regarding the EA after the close of the public comment period within a reasonable and practicable timeframe.

Comment C2

- The Pacific view of developments within the region, as reflected by South Pacific Forum decisions, is that the region should not be used as a dumping ground for other countries' wastes. The Forum has in the past opposed the use of the Pacific environment for potentially harmful actions of other nations, such as nuclear testing and the movement of nuclear and hazardous wastes through the Pacific, and has called on other nations to respect the wishes of its people.

FAA Response: We share SPREP's concerns and will consider the interests and wishes represented by the South Pacific Forum. We believe that a focused discussion and exchange of information on the proposed Sea Launch project in the region will satisfactorily address all points raised by the comments. We also wish to emphasize the proposed launch activity will not generate or involve nuclear wastes, and in fact it represents a new use for technology that previously had only defense-based applications.

Comment C3

- There are potential human safety concerns. The EA notes the Kiribati practice of fishing for ocean fish stocks to provide for nutritional needs. However, while there are plans to warn shipping of launch times, there is no mention of plans to warn Kiribati fishing boats of falling debris or potential kerosene slicks.

FAA Response: EA Section 4.5.5, "Coordination with Vessel and Air Traffic," indicates Sea Launch would provide all necessary warnings to mariners and aviators potentially affected by its launch activity. In this regard, prior to the first launch, Sea Launch Company intends to work with the Republic of Kiribati and representatives of industrial fishing fleets that operate in the region to coordinate the administrative process by which such notice would be given. Sea Launch Company would also like to work with SPREP and other appropriate groups in identifying how best to notify local fishing vessels.

Commercial launch operators throughout the world currently coordinate with affected governments and organizations to provide safety notices prior to each launch. For

launches conducted under our authority, Notices to Mariners and Aviators are handled for all regions affected through the United States Coast Guard and our Central Altitude Reservation Function, respectively. Additionally, no launches would be conducted unless all fishing vessels are clear of the predetermined safety zone surrounding the Launch Platform. Visual and radar sensors will be used to verify this. The administrative details involved with issuing these notices will be worked out with the appropriate authorities.

Comment C4

- The EA fails to provide adequate detail in a number of areas, including potential impacts on rare and endangered species, marine mammals and migratory birds. It does not provide detail of the biological environment of the launch sites or the potential debris deposition areas.

FAA Response: We considered the record of oceanographic research conducted in the deep water region of the east-central equatorial Pacific Ocean that includes the proposed launch site and stage deposition areas. This research was found to support our conclusions regarding potential impacts made in the EA as detailed in the responses below.

Comment C5

- The EA provides no details of contingency plans in case of accidental or catastrophic release of pollutants. There is no indication that an Environmental Management System has been developed for the proposal. Neither is there an indication of whether any independent authority has a compliance role or a role in monitoring the implementation of the proposal. There is no provision for a Marine Pollution Contingency Plan or an Environmental Monitoring Programme.

FAA Response: EA Sections 4.1, "Overview" and 4.5.1, "Design, Operation, and Maintenance of the LP and ACS," clearly reference the requirements of maritime authorities responsible for approving and overseeing Sea Launch Company contingency plans. In particular, emergency preparedness and response would be separately regulated and administered by the International Maritime Organization (IMO), Liberia as Flag State, and the Government of the United States as Port Control State (including the U.S. Coast Guard). We have coordinated with appropriate entities to ensure these measures are in place. We will make these specific contingency and monitoring plans available to the relevant authorities upon request.

The environmental management system to be used by Sea Launch is included in the documents submitted to us to meet requirements of the launch licensing process. We will also make these documents available for review upon request. Sea Launch Company integrates the management of environmental safety with safety of people in a single safety plan for the launch system (EA reference SLLP, 1997). We believe this approach would effectively meet the intent of a standardized Environmental Management System discussed in international circles and noted in this comment by SPREP. Provisions for

managing and measuring potential effects are discussed in the response to Comment EM3.

Comment C6

- While the EA holds out the prospect of significant socio-economic benefits for the community of Long Beach California, which would become the project's home base, there are no socio-economic benefits for the Pacific in general and Kiribati in particular. Instead, there may be significant environmental and human safety disadvantages, which cannot be quantified because the EA does not contain adequate detail.

FAA Response: We believe that SPREP's mission of promoting sustainable development in the Pacific and our mission of licensing and regulating safe commercial launches are compatible. With increased communications and discussions between Sea Launch Company and the Government of Kiribati regarding the Sea Launch operations in the Pacific region, this proposed project would support the SPREP mission and provide a benefit to the People and Government of Kiribati. Sea Launch has applied for a launch-specific license and later plans to apply for a launch operator license. We will reevaluate existing environmental documentation at that time to determine its adequacy.

Comment C7

- The proposal to license a launch from an offshore facility in international waters is acknowledged to be without precedent. (Section 1.3.3) Yet despite the unusual nature of the proposal, the Precautionary Principle has not been followed. On the contrary, in the absence of data it has been concluded that environmental values at the launch site and spent rocket stage disposal sites are low and impacts are likely to be negligible.

FAA Response: As discussed in specific comments below, we have followed a precautionary approach for this project and that data available for the region and, hence, for the launch and stage deposition areas, are adequate to demonstrate a finding of non-significance of impacts.

Comment C8 - SPREP Conclusions

- The information supplied in the Sea Launch Environmental Assessment of the impacts of the SLLP proposal on the environment is, in the opinion of SPREP, insufficient to permit a Finding of No Significant Impact (FONSI) to be issued. SPREP would recommend that the proponents be directed to carry out a full and comprehensive Environmental Impact Statement (EIS). This should encompass an Environmental Impact Assessment using the framework of the International Standards Organization (ISO) 14000 Series Standard Environmental Management System.

FAA Response: As indicated in response to Comment C7, we used available information to propose the finding of no significant impact, and we believe the additional analysis recommended by SPREP would not significantly change the results of the EA nor

substantively change the conclusions. However, we agree that a focused monitoring program of effects of the proposed launch activity over time would be appropriate. We do find, additionally, that applicable environmental regulatory standards have been met.

SPREP Specific Environmental Comments on the Sea Launch Environmental Assessment and the Proposal by the Associate Administrator for Commercial Space Transportation to Issue a Finding of No Significant Impact

SPREP's technical comments have been made within a very brief time frame. The purpose of attaching these initial comments is to indicate the areas that require further investigation, preferably through the preparation of an Environmental Impact Statement by the proponents.

Air Quality

Comment A1

- Impacts to air quality may occur during coupling and de-coupling of fuel lines and apparatus prior to launch of the rocket (Section 4.3.1). The impacts are not quantified in the document.

FAA Response: Due to the design of the automated fueling equipment which would purge the lines after fueling, the coupling and de-coupling of fuel lines would result in the release of very little kerosene and liquefied oxygen (LOX) vapor. A small quantity of vapor would disperse and breakdown in the equatorial atmosphere to non-detectable levels very quickly, i.e., within hours, as is described in EA Section 4.3.2.1. Dispersion modeling (EA Section 4.3.2.4) of the launch CO plume (approximately 36,100 kg produced at the rate of 656 kg/sec for 55 seconds) indicated that the CO plume from each launch would dissipate in a matter of days. This does not take into account the effects of atmospheric processes. A much smaller release of vapor associated with the fuel lines, therefore, would dissipate even faster and over a much smaller area. The amount of vapor involved in this circumstance would not result in a quantifiable impact.

Comment A2

- An unsuccessful ignition attempt would release LOX vapor and approximately 70 kg of kerosene would be discharged into the ecosystem as fuel lines are flushed (Section 4.3.1). It is not stated how many unsuccessful attempts are likely to occur based on previous launch experience. The cumulative impacts of successive unsuccessful ignition attempts based on previous experiences have not been assessed.

FAA Response: Based on the calculations of the Sea Launch partners who have experience with these systems, it is anticipated that defueling would be required roughly once every 87,000 missions. This is based on Russian and Ukrainian reports that kerosene defueling of the Zenit rocket has never been required during an actual launch, although it has been done many times during testing of the launch erector and automated fuelling systems. As part of its own planning process, however, Sea Launch Company did consider the potential of a kerosene defueling, and these data were provided to us. For this reason, we addressed the defueling possibility in the EA.

Any potential incident is considered seriously by launch operators, and extensive testing is done to ensure a successful launch. The scenario referenced in this comment has

particular relevance to Sea Launch since the LOX supply on the Launch Platform is sufficient for only two launch attempts for each disembarking from the Home Port. Thus, if a second launch attempt were unsuccessful for any reason (including kerosene defueling), both ships would have to return to the Home Port to correct the malfunction and re-provision the ships.

In its analysis of this scenario, therefore, we concluded the lost LOX would mix with and be indistinguishable in the atmosphere within minutes from either one or two aborted launches. As described in EA Section 4.3.1, all but roughly 70 kg of kerosene would be returned to the Launch Platform's fuel tanks. The 70 kg of kerosene that would be lost would be released from the fuel lines during the automated uncoupling of the lines. The Launch Platform deck configuration would cause the kerosene to fall to and wet the flame bucket. This structure is a tent-shaped structure, 18 meters long, designed to deflect the rocket's exhaust away from the water surface and in a horizontal direction to the starboard and port sides. This massive structure has numerous structural members that would serve to catch and contain virtually all of the spilled kerosene. While nearly all of the kerosene would be contained, some would likely splash off the deflector and fall to the ocean surface below. Because of safety concerns, no one would be on board the Launch Platform during this time, and Sea Launch would not attempt to recover the kerosene inadvertently released should defueling be necessary.

The kerosene lost to the air or ocean surface from defueling would be chemically or biologically broken down into more basic molecules as described in EA Section 4.3.2.1. The small quantity of kerosene released to the environment would cause an impact as described in EA Section 4.3.2.1, but over an area of a few square meters. Impacts from such an event would not be significant or even detectable over time.

Comment A3

- Potential environmental impacts from combustion emissions released into the atmosphere over the twenty (20) year period have not been assessed (Section 4.3.2.2).

FAA Response: EA Section 4.3.2.4 indicates tropospheric impacts would be below levels of concern within a few days. With a gap of two or so months between launches and the rapid rate of dispersion of emissions in the troposphere, the effects from one launch would be non-detectable well before the next launch. Similar comments apply to the impacts in the stratosphere (see EA Section 4.3.2.5). Observations of ozone destruction in the exhaust trails of rockets indicate that the loss of ozone in these trails is temporary, and normal ozone levels are re-established within several hours to a day or so. With a two-month period between launches, the very small loss of stratospheric ozone that may be attributable to a Sea Launch would be replaced by the natural generation and migration processes of the atmosphere, and return to natural levels long before the next launch. Research currently underway regarding the impacts of rocket exhaust on stratospheric ozone has indicated these results. However, the research, which is lead by Aerospace Corporation under the program management of Dr. Martin Ross, is on going and additional information will be considered as results are available.

- "Rocket Impacts on Stratospheric Ozone (RISO) Project Results," presented by Dr. Robert R. Bennett, Thiokol Propulsion Group, FAA, Washington, DC, April 8, 1998.

- Ross, M., "Rocket Impacts on Stratospheric Ozone," American Institute of Aeronautics and Astronautics Paper 97-0525, Jan. 1997.

- Ross, M., "Local Impact of Large Solid Rocket Motor Exhaust on Stratospheric Ozone and Surface Ultraviolet Flux," *Journal of Spacecraft and Rockets*, Vol. 33, No. 3, 1996, p. 435.

Comment A4

- Launch effects on the atmospheric boundary layer up to 2000m would be short term. However the impact of prevailing winds on the dispersal of pollutants during El Nino could vary. Significant disruption to normal ocean and atmospheric conditions in the Pacific have occurred in previous El Nino events and the impact they would have on air quality in the vicinity of the launch and on downwind land areas during El Nino events has not been addressed. The reference to El Nino effects (Section 3.4) relates only to the productivity of ocean waters and not to altered wind patterns.

FAA Response: Under the influence of the El Nino effect, surface winds in the equatorial Pacific in the launch area are expected to be primarily to the east in direction. This would carry emissions away from Christmas Island. The closest land masses to the east, the Galapagos Islands, are approximately 6,900 km distant from the launch area. Winds that transport the launch emissions toward the Galapagos Islands would disperse the emissions to non-detectable levels well before reaching the islands. (See analysis in EA Section 4.3.2.4). Stagnant conditions would cause launch emissions to remain and gradually dissipate in the launch area.

Comment A5

- The cumulative effects on air quality of the planned six missions per year or 116 launches over the twenty (20) year period of the project (Section 2) have not been addressed.

FAA Response As discussed in response to Comments A3 and A6, and as shown in the analysis in EA Sections 4.3.2.2 through 4.3.2.6, the effects attributable to any one launch would not be detectable within a few days to a week or so after each launch. As such, we have determined there would be no significant cumulative effect over a twenty-year period. This conclusion is consistent with the known effects from launches from fixed space launch facilities (e.g., Cape Canaveral AS, FL; Vandenberg AFB, CA; and Kennedy Space Center, FL) in use for decades by the U.S. government. Studies conducted at Kennedy Space Center regarding the cumulative effects of Shuttle launches in terms of both near and far-field impacts on the environment (e.g., toxic effects of HCl or acid rain on vegetation) have shown minimal effects.*

- Schmalzer, P.A., C.R. Hall, C.R. Hinkle, B.W. Duncan, W.M. Knott, and B.R. Summerfield, 1993, "Environmental Monitoring of Space Shuttle Launches at

Kennedy Space Center: The First Ten Years," Presented in the 31st Aerospace Sciences Meeting & Exhibit, Reno, NV, American Institute of Aeronautics and Astronautics, Washington, DC.

- Bionetics Corporation, "STS-5 Launch Effects Summary Report," Kennedy Space Center, Florida, KSC-STS-Effects-STS5, July 1983.

- Bionetics Corporation, "STS-32 Launch Effects Summary Report," Prepared for NASA Biomedical Operations and Research Office, Contract No. NAS10-11624. BIO-ENV-007, March 1990.

Comment A6

- Each launch will produce 181 tons of carbon dioxide (CO_2) emissions and 36 tonnes of carbon monoxide (CO): two important greenhouse gases. Annual CO_2 emissions from the six launches proposed for each year will approach 1000 tonnes, with a further 200 tonnes of CO. The impact of these emissions from the total of 116 launches (the projected life span of the proposal) has not been addressed.

FAA Response: The figures referenced by SPREP in the comment above refer to tropospheric CO and total atmospheric CO_2. From EA Table 4.3.2-2, the total release per launch of CO to the entire atmosphere is estimated to be 113 tonnes, rather than the 36 tonnes mentioned in the comment. However, CO is not considered a major greenhouse gas - at least relative to CO_2, CH_4, N_2O, and various halogenated compounds. CO can, however, be oxidized to form CO_2, perhaps the most widely recognized of the greenhouse gases.

To place Sea Launch emissions in context, consider the magnitude of other sources of man-made CO_2 in the atmosphere. For example, burning fossil fuels is estimated to place roughly five billion tonnes of CO_2 into the atmosphere each year[2]. The annual emission of CO_2 associated with the rocket launches is approximately 2,200 tonnes, assuming a one-to-one conversion of CO into CO_2. Sea Launch, therefore, would contribute less than one-millionth of the effect due to fossil fuel combustion alone. This does not take into account other man-caused and natural sources of greenhouse gases. In summary, we do not believe emissions impact due to Sea Launch activities would be significant.

Comment A7

- Emissions to the troposphere come from combustion of LOX and kerosene. Emissions would form CO_2 and oxygenated organic compounds. During flight times emissions would include nitrogen oxide in the exhaust trail which would form nitric acid and nitrous acids and these nitrogen compounds would cause a reduction of stratospheric ozone. The document is unclear as to the level of global ozone depletion that would occur over the twenty-(20) year lifespan of the proposal (Section 4.3.2.5). As the EA says (Section ES-4): "The exact chemistry and relative

[2] O'Riordan, Timothy. Ed., 1995; Environmental Science for Environmental Management, Longman Group Limited, Essex, England.

significance of these processes are not known." The impact of the process that causes depletion of stratospheric ozone should be determined.

FAA Response: The quoted material in the SPREP comment refers to the effect of the rocket re-entry into the atmosphere, not to the general impact of rockets on stratospheric ozone. While we agree that more research would lead to a greater understanding of the various mechanisms that relate operation of rockets to stratospheric ozone, current research referenced in the EA indicates the effect of the rocket launching industry on stratospheric ozone is not significant. By extension, the effect of Sea Launch, which does not use the type of chlorine-based rocket fuel most associated with depletion of stratospheric ozone, would not be significant. As mentioned above, there is on going research concerning the impacts of rocket emissions on stratospheric ozone (RISO Project – see response to comment A3). One aspect of this research is the attempt to compare the environmental impacts of emissions from solid rocket motors versus those systems using a hydrocarbon fuel and LOX, like the proposed Sea Launch system. We are scrutinizing this research and it will be included in consideration for launch licensing environmental determinations once complete, validated and verified.

Waste

Comment W1

- It is not stated what quantity of particulate debris and residue would be generated by the launch and how it would be collected from the Launch Platform or from the water.

***FAA Response*:** The materials referenced in this comment are particulate carbon residues resulting from LOX- kerosene combustion and any metal debris that would result from a launch. The relevance of carbon residue in EA Section 4.3.3 is somewhat overstated because the amount emitted by rocket LOX-kerosene systems is usually considered to be incidental, on the order of a few kilograms, due to the rocket's combustion efficiency. This small quantity of particulate carbon would be readily incorporated into the ocean's carbon cycle (EA Section 3.4).

The Launch Platform structure and the equipment installed on it were designed to withstand with minimal damage the force and heat of a launch. The EA acknowledged, however, that some debris might be produced during a launch if equipment and insulating metal shields are damaged. As indicated in EA Section 4.3.3, this hardware would be dismantled and handled on board as waste and returned to the Home Port for recycling or disposal. In addition, the rocket hold-down clamps mentioned as a type of debris in EA Section 4.3.3 are a part of the rocket. As explained in EA Section 4.3.1, the clamps stabilize the rocket by connecting it to the Platform and are forcibly released during a launch. The loose clamp debris that the EA assumed might be generated would be in quantities no greater than a few kilograms. Any debris generated during launch would be lost to the ocean as fragments or remain connected to Stage 1, while pieces that remain on the platform would be collected and brought to the Home Port. Disposal of any debris

would be accomplished in accordance with all federal, state and local requirements at the Home Port.

Comment W2

- With 116 launches over a twenty (20) year period the cumulative impact of dumping approximately 6000 tonnes of debris (Stage 1 hardware, fairing halves, Stage 2 hardware and Block DM-SL sleeve adaptors, not including debris expelled from the launch platform during ignition) has not been considered or assessed.

FAA Response: This response addresses several issues identified in the comment including debris hitting the ocean surface, the same debris when it settles on the seafloor, and the fairing. Other platform debris is addressed in the Response to Comment W1.

First, regarding debris that falls to the ocean and sinks, we believe the surface area of the debris to which the ocean is exposed, and not its collective mass, is a more meaningful measure of impact and risk. In the case of Stage 1 and 2 hardware, while each stage weighs 28,569 kg and _9,109 kg total respectively and may likely break up on reentry, each launch results in a maximum impact area of approximately 404 and 127 square meters of ocean surface, respectively. This assumes the tubular shape of the rocket is simply opened and flattened, an approach that would conservatively maximize the potential for falling material to strike something on the surface or contact something on the seafloor.

This material would fall onto an area roughly defined by ovals, shown figuratively in EA Figure 4.3.2-1, covering 1,178,000,000 and 12,570,000,000 square meters respectively. Thus for any launch, at most only 0.00003% and 0.000001% of the ocean surface in the Stage 1 and Stage 2 impact zones, respectively, would be impacted by falling debris. These figures are much the same for any rocket launched anywhere in the world.

In the case of the fairing, the maximum size if flattened would be 149 square meters, the fairing deposition area would be 4.712×10^9 square meters, and at most only 0.000003% of the ocean surface would be at risk from impact from fairing debris.

The actual area at risk from any of this debris would be, therefore, very small. Further, the likelihood that falling debris would strike an animal on or near the surface, or strike a ship on the surface from one or from all proposed launches is considerably smaller.

Given these assumptions and this quantitative approach, it may also be useful to consider the historical effect of rocket debris from launches worldwide. In over forty years of approximately 4,000 orbital rockets being launched from over thirty locations throughout the world, there have been no recorded instances of any impact or damage to ships or boats in areas where stages fall. This is the case despite the fact that many launch sites are situated in coastal areas characterized by relatively high rates of commercial, subsistence and recreational vessel traffic, and in direct proximity to the diverse and productive ecosystems that are common along many coastlines (e.g.,_Kennedy Space

Center, Florida; Vandenberg AFB, California; Wallops Flight Facility, Virginia; Kagoshima Space Center and Lambda Launch Complex, Japan).

The Notices to Mariners and Aviators, required of Sea Launch Company and all launch operators as a condition of a launch license, when properly coordinated and responded to, serve to further ensure safety of the public. As explained in the Response to Comment C3, Sea Launch Company would work closely with all affected organizations in the months prior to the first and subsequent launches to ensure proper notices are provided.

The second part of this comment addresses the effect when the material settles to the seafloor. In this case, accumulation of debris from multiple launches may be of greater concern. Over the planned 116 launches, using the figures stated above for Stages 1 and 2 and assuming the pieces come to lie perfectly flat on the bottom and do not overlap, the maximum amount of sea bottom that could be covered by the rocket debris is roughly 17,280 square meters, or 0.0004% of the total area of 13,750,000,000 square meters at risk on the sea bottom. This further assumes the material does not drift during descent from currents in the water column beyond the perimeter of the impact area on the surface. More likely, however, the stages would land in curved and complex shapes. This would reduce still further the area on the bottom directly impacted by the debris, and would provide much more new surface area and nooks and crannies, i.e., the insides and outsides of the spent stages, that would begin to harbor marine life.

That sea life colonizes human-induced habitat such as shipwrecks, rip rap jetties, and breakwaters made from boxcars and tires is well documented. Therefore it is reasonable to infer the same thing would happen with rocket stages that settle in deep waters of the Pacific Ocean – even though that particular ecosystem happens to be less well studied.

Finally, based on the launch industry's experience with composite fairings, the two halves of the Sea Launch fairing will break up into a number of rigid pieces. Each piece will either float at or below the surface for a number of years, or become waterlogged and sink within a few days. Unlike plastic debris such as fishing nets, rope, string, and packaging materials that readily ensnares or is ingested by sea life, fairing pieces are relatively large, solid sheets of material. As such, floating fairing pieces will offer resting places for sea birds and provide smaller sea life shade and some protection from predators.

To summarize, our determination of safety with regard to falling rocket stages and fairing pieces is based on the frequency of ship and air traffic and biological activity in the down-range direction relative to the history of launches worldwide, and operational practices that will be implemented . Both ship and plane traffic and the concentration of vulnerable marine life are known to be low in that part of the Pacific Ocean - relative to other areas of the world's oceans that have been in the path of rocket launches throughout the world for decades without an incident. On the basis of the EA analysis as well as the long and successful history of government and industry launches throughout the world, we find there would be no significant effect from Sea Launch Company launches, as initially expressed in EA Section 2.2.2.

Comment W3

- This EA has been prepared to support a launch-specific license and launch operator licenses (Section 1-1). The document does not state if an environmental assessment will be required for each launch activity. As no detail is given of the satellite payload other than the description *telecommunications, scientific and research* (Section ES-1, ES-2) there is the potential scenario of unknown high level contaminants being transported to the Pacific and launched without assessment of their potential impacts under a failed mission scenario.

FAA Response: The EA is intended to support an environmental determination in the consideration of a launch operator license under which the proposed site is for the exclusive use of the license applicant including up to six launches per year. If Sea Launch proposes a significant change to the original plan submitted as part of the launch license application we would re-evaluate the EA to determine whether additional NEPA assessment or documentation is necessary. Examples would be a change in the launch location, significant increases in the number of launches, and significant changes in the type of payload. Sea Launch has indicated it does not foresee any such changes.

Satellite payloads currently manifested by Sea Launch are all common, earth-orbiting data transmission satellites. We have previously analyzed environmental effects of these satellites, including possible contamination from a failed mission scenario, and determined them to be non-significant in our 1986 Programmatic Environmental Assessment (EA Section 1.3.4). Therefore, we analyzed only unique aspects of the Sea Launch license application for potential environmental significance.

Comment W4

- The proponent, while stating compliance with the International Convention for Prevention of Pollution from Ships 1973 as amended by the Protocol of 1978 (MARPOL 73/78), has not provided any indication that monitoring, auditing or reporting of waste discharges will be carried out. (Section 4.5.1, B.5.2). A Marine Pollution Contingency Plan has not been provided in the document.

FAA Response: Please see response to Comment C5.

Comment W5

- It is noted that some discharge of wastes from the launch platform is proposed (e.g. flushing of fuel line in the event of a failed launch; debris blown from the launch platform during launch). Such a view of the ocean as a waste dump is contradictory to the intent of MARPOL.

***FAA Response*:** We and Sea Launch view the ocean as an environment and resource to be conserved and protected. While we are concerned about the occasional loss at sea of extremely small quantities of materials as a result of ordinary launch operations, we have determined that such occurrences would not constitute ocean dumping under MARPOL or any international convention. We are, however, requiring a monitoring program to ascertain continued adherence to applicable standards.

Comment W6

- A Marine Pollution Contingency Plan has not been provided in the Sea Launch EA document.

FAA Response: Please see response to Comment C5.

Noise

Comment N1

- In Section 4.3.2.1 no comparative examples of the generated noise level are provided to show the impact that the noise level of around 75dB would have on nearby marine organisms.

***FAA Response*:** Scientific literature, including those cited in the EA, indicates the noise generated by rockets and airplanes overflying marine life causes a startle reaction among mammals, birds and reptiles that are on shore during the noise event. Louder or more prolonged noise will cause the wildlife to rush into the water. Based on the studies and adaptability of marine life observed at rocket launching sites and airports situated in coastal margins throughout the world, including many tropical environments, there is no indication the marine organisms will be significantly affected by the occasional launches proposed by Sea Launch Company. Additionally, the launch location and range, relatively low levels of nutrients in this open ocean area sustain low levels of phytoplankton, which sustains low levels of zooplankton, which sustains few small fish, and so on up the food chain. Expressed conversely, large and diverse populations of fish, marine mammals, reptiles, and birds generally inhabit the coastal margins and seldom frequent the more desolate, less productive open ocean waters. *

- Versar, Inc. *Final Environmental Assessment Vandenberg Air Force Base Atlas II Program.* August 1991.
- National Aeronautics and Space Administration. *Draft Tier I Environmental Assessment*. April 1996.
- ENSR Consulting and Engineering. *Environmental Information in Support of a Request for a Letter of Authorization for the Incidental Harassment of Pinnipeds by the Launches of McDonnell Douglas Aerospace Delta IIs at SLC-2W.* Camarillo: ENSR, July 1995.
- National Aeronautics and Space Administration. *Draft Supplemental Environmental Impact Statement for Sounding Rocket Program.* Washington, August 1994.
- Brown & Root Environmental. *Environmental Assessment of the Kodiak Launch Complex*. Aiken: Brown & Root Environmental, June 1996.

Biological and Ecological Impacts

Comment B1

- The description of the marine environment at the launch site and spent rocket stage disposal sites is inadequate. Significant inferences have been made in the EA from extremely limited and generally inferred data based on plankton ecology. From this limited data on plankton, conclusions have been derived about the importance of the area to fisheries and large marine animals, including marine mammals that may invoke requirements under the U.S. Marine Mammal Protection Act.

***FAA Response*:** We considered available data representative of all ecological communities in the Pacific Ocean region and data for the areas specifically affected by the proposed launch activity and our assessment of these data is reflected in the EA. As part of the routine administration of our responsibilities under E.O. 12114 with guidance provided by NEPA, our analysis took into account the standards in all U.S. environmental protection laws. See response to Comment W2.

Comment B2

- The area supports large-scale high technology export oriented industrial oceanic fisheries which rely on the functional integrity of the Western Pacific warm pool ecosystem. However, the Forum Fisheries Agency (FFA) and the Secretariat of the Pacific Community (SPC) have not been consulted about fisheries values and resources in the vicinity of the launch site.

FAA Response: Initial research by us and Sea Launch Company indicated low levels – and certainly low relative to the areas farther west in the Pacific - of both commercial and subsistence fish stocks and fisheries activity in the region at and east from the launch site. This conclusion was reinforced by an apparent lack of published data about catches in the area directly affected by proposed launches by Sea Launch Company. Consultations with Pacific fisheries experts revealed that while there are numerous high-scale fishing activities that take place in the Central and Eastern Pacific Region, none are specifically located in the vicinity of the proposed launch site.[3] The likelihood of Sea Launch operations impacting the fishing industry is very low as the Pacific Region is large and boats are spread over a wide area. There does not appear to be any area in that part of the Pacific where fishing boats collect in high density. We do, however, welcome the opportunity to review this subject in more detail and to avail itself of new data from these other sources.

Comment B3

- It is not stated what quantity of heated fresh water and residual contaminants from the flame bucket will be released into the ecosystem during the launch. (Section 4.3.1)

FAA Response: The fresh water tanks on the Launch Platform hold 27,474 gallons. It is estimated approximately 80% of this water would be evaporated by the heat of the rocket

[3] Personal communications with Bill Gibbons-Fly. National Oceanic and Atmospheric Administration (NOAA) Pacific Fishing Specialist.

exhaust, while the remainder would be dispersed by the force of the exhaust and settle over a wide area on the ocean surface. The residual contaminants from the Platform surfaces, including those remaining on the flame bucket, if any, and exhaust constituents are discussed in the response to Comment W1 and in EA Section 4.3.2, respectively.

Comment B4

- It is stated that there will be mortality of plankton from launch and flight activities, but this is not quantified. (Section 4.3.2.1).

***FAA Response*:** We believe plankton mortality was appropriately considered in terms of the significance to the ecology represented by plankton death or impairment that would result from the proposed launch activity (EA Section 4.3.2). Given that research in the region has documented natural patchiness of plankton densities and inherent variability in naturally occurring stressors on the surface and at various depths (Yoder, 1995; Murray, 1994, Philander, 1992; and Vaulot, 1995), any quantification of plankton mortality would necessarily be statistically indeterminant and of limited if any value.

Comment B5

- With 116 launches over a twenty (20) year period, the cumulative impact of the discharge to the ocean of approximately 550 tonnes of kerosene has not been considered or assessed.(Section 4.3.2.1).

FAA Response: The facts surrounding this comment need to be updated in two areas as was first indicated in our introductory Response to SPREP's opening Summary.

First, when the draft EA was prepared, the only information available to Sea Launch Company and us was the historical use of the rocket by the former Soviet Union, which developed the rocket to launch military satellites and other payloads. Sea Launch Company anticipated that there would be substantial improvements in propellant use as this technology was used to launch and deploy commercial satellite payloads (EA Section 4.3.2.1, pg. 4-5), but instead chose to report more solid, historical data.

Given the incentives of launching commercial satellites where each kilogram of payload is more critical, the Russian and Ukrainian partners have achieved some notable efficiencies in the use of the propellants and from refinements in launch planning. As a result, the initial figures provided for kerosene associated with falling stages (in EA Section 4.3.2.1) of 3,489 kg (1,097 gallons) and 1,060 kg (333 gallons) in Stages 1 and 2, respectively, have so far been reduced to 2,000 kg (629 gallons) and 450 kg (141 gallons). Sea Launch Company has directed its Russian and Ukrainian partners to do the work necessary to achieve additional reductions in unused propellants, given the clear benefit of weight reductions and material losses to the environment.

The second set of information that needs to be updated concerns the likelihood that Stages 1 and 2 would break up in flight and release the residual propellants high in the atmosphere rather than falling intact and breaking up in contact with the ocean surface. The EA (Section 4.3.2.1, pg. 4-5) described and considered the impact of both

possibilities since at the time it could not be determined which scenario would be most probable.

Data now available on the strength properties of Stages 1 and 2 and their historical use in the former Soviet Union support the conclusion that Stage 1 will sometimes break up and release residual propellants during descent, while Stage 2 will always break up during descent and release its residual fuels at a high altitude. In explanation, each rocket stage would behave a bit like an egg, which is strong if compressed along its long axis from point to point and very weak if compressed about the middle. In the same manner, each stage is designed to be very strong when travelling vertically in a straight path, and the rocket motors are designed to continually correct the orientation of the rocket in flight to ensure this preferred alignment. When stressed side-to-side, however, the rocket has severely reduced structural strength.

When the thrust of each stage is terminated and each stage is separated from the remaining rocket, the speed of Stages 1 and 2 would be 2,620 m/s and 6,380 m/s (meters per second), respectively. The control of the guidance system that ensures proper orientation of the hardware would also be terminated for each stage, causing each stage to tumble. The respective speeds and physical forces on each tumbling stage would possibly cause the rupture and release of the remaining propellants in the case of Stage 1, and would ensure rupture and release in the case of Stage 2. We expect that in either case, kerosene releases would occur above 60 km.

Given the confirmation that much of the unused kerosene from Stages 1 and 2 during normal launches would be released at extremely high altitudes, the impact of kerosene on the ocean surface would be much reduced from that described in the EA as an initial and most conservative scenario. We find it appropriate, however, to consider its effect at high altitudes in the atmosphere.

Research done on the release of fuel from airplanes has shown that jet fuel, which is very similar in chemistry and physical behavior to kerosene, is completely evaporated within about 1,000 meters from the point of release.* (Note: The release of jet fuel is a common action taken by pilots who need to lighten the weight of a plane and shed flammable materials when in potentially dangerous situations.) At the point of release, winds disperse the released liquid over a wide area resulting in a mist. Evaporation of all but the largest droplets then occurs within a few minutes, because evaporation is affected more by droplet size, i.e., the surface area on the drop, than the cold temperatures at high altitudes. The resulting kerosene vapors will then breakdown with the addition of heat from the atmosphere and sun to the carbon dioxide and water.

✳ From an analysis performed by The Boeing Company, 1980. This is publicly available through the FAA.

Comment B6

➢ It is stated (EA Section 4.3.2.1) that fallout debris would settle, become assimilated and create new habitat areas. This statement is not supported by descriptions of

existing benthic habitats in the proposal area and makes assumptions of the capacity of the environment to recolonise the areas disturbed by debris settlement. Assessments of the benthic communities of the proposal areas are inferred and not based on actual site data (EA Section 3.3).

FAA Response: We believe the general body of knowledge accumulated during research on the benthic and other habitats of the Pacific Ocean is directly applicable to the more specific – yet still very large – areas potentially affected by Sea Launch. In other words, it is likely that the 13 million square kilometers of ocean seafloor estimated to be potentially affected by rocket stage debris settling on the bottom (response to Comment W2) are representative of what has been learned for deep ocean waters in the region as a whole.

Comment B7

- Moreover the two worst case scenarios given in the document identify that the biological and ecological impacts would be significant in the short term. However, the cumulative effects of possible worst case scenarios are unknown and are potentially significant.

***FAA Response*:** A cumulative environmental effect due to multiple worst case events resulting from the proposed Sea Launch activity is not required to meet applicable standards for several reasons. Commercial launch service providers in the launch industry are motivated to have successful launches. Each failure is extensively studied to determine its cause, and another launch does not occur until the cause of failure is identified and corrected to ensure it will not occur again. Failures that may occur from different causes would most likely affect different locations, ensuring that the individual effect of each failure would be distinct and therefore the impacts would not accumulate. In the case of Sea Launch, multiple failures on the Launch Platform would damage the platform, but the ocean currents would serve to dissipate the short-term effect of each failure. This is in contrast to the effects that could occur due to multiple failures from launches conducted from a launch facility on land.

Comment B8

- As stated in the document the risk of debris striking land masses in the event of failure "is very remote"(Section ES-5, 4-13). However, according to the document the flight path in subsequent launches after the first launch would be re-evaluated according factors including commercial cost factors and may be re-routed to pass over the Galapagos Islands and the continental land mass including Ecuador.

FAA Response: While a flight directly over the Galapagos would conservatively meet risk criteria established for Sea Launch, SLLP selected a more northern routing to totally eliminate risk to the main island group during the first launches until routine successful operations have been established. It is common in the launch industry, however, to reevaluate and modify initial plans as more data become available on the reliability of the technology and the demonstrated success of the system. Sea Launch Company has identified debris striking a land mass as a remotely possible event, and, thus, it was

included in the EA. As noted in response to Comment W3, this is an example of a change that would be subject to our re-evaluation as part of the NEPA process.

Comment B9

- The Precautionary Principle has not been adhered to. On the contrary, in the absence of data it has been concluded that environmental values at the launch site and spent rocket stage disposal sites are low and impacts are likely to be negligible.

FAA Response: We believe that Sea Launch has been conservative in providing information and analyses to us for the environmental finding to support its launch license application decisions.

Social and Economic Considerations

Comment S1

- The document offers the prospect of significant economic benefits for the community of Long Beach. There are no apparent economic benefits for Kiribati, the country nearest the launch site, or for the Pacific as a region.

FAA Response: We and Sea Launch believe the potential for economic benefits for Kiribati and, indirectly, for the region as a whole will be addressed more fully in the coming months in developing discussions between Sea Launch Company and the Government of Kiribati. The initial focus by Sea Launch Company would be on the types and extent of services that may be needed and available on Kiritimati Island to support the initial launch, followed by discussions of services that would be necessary or desirable on an ongoing basis.

Comment S2

- The document has stated a positive contribution to the economy of Kiritimati Island only in the event of an emergency situation. It has not quantified these supposed positive benefits (EA Section 4.4). Refer to Health and Safety for additional comments.

FAA Response: Emergency use of Kiritimati Island – as first considered by Sea Launch Company and documented in the EA - would involve the routing of Sea Launch personnel during rare instances of emergency medical conditions that can not be treated by on-board medical staff. This is expected to be comparable to existing activities for a passing cruise ship that needs to transfer and evacuate someone with a medical problem.

As the date of proposed first launch approaches, Sea Launch Company is planning for the possibility of medical evacuations and other emergency situations, while taking steps to protect and care for the people on board the vessels and eliminate the possibility of technical interruptions during a launch. Sea Launch Company hopes that discussions with the Government of Kiribati and potential service providers on Kiritimati Island in the months ahead will lead to specific plans for these and other needed services.

Comment S3

- Oceanic fishing, primarily for tuna, is undertaken by 1300 vessels from 21 countries, one-third of which are based in the Pacific islands employing 6-8% of the work force. These fisheries have an export value of $US 1.7 billion (1995) and contribute about 10% of the GDP of the Pacific islands. The EA implies that the Sea Launch operations will not impact on fisheries because there are few fish in the region to be affected by the proposal. There are no facts or statistics given to back up this claim.

FAA Response: We believe the data used in assessing the impacts of the proposed activity support its conclusion that - in relative terms and for the Pacific region as a whole - the area directly affected by the proposal is not currently exploited as much as other discrete areas by the fishing fleets operating in the Pacific region. Consultation with Pacific fisheries experts reveal that although there are numerous high-scale fishing activities that take place in the Central and Eastern Pacific Region, none are specifically located in the vicinity of the proposed Sea Launch launch site.[4] The fishing boats in the area do not have a specific area that they fish, or any pre-planned schedule for fishing activities in specific locations. The exact locations that each fleet or individual boat fishes is not generally known as they each have ideas about what areas are productive. Numerous countries fish in the Pacific including China, Japan, Taiwan, and the United States. There are approximately 30-35 boats from the United States at any given time in the Pacific. The number of fishing boats that may be found in the Pacific from other countries is unknown, however, it is estimated that Taiwan might have as many as 40 or 50 at a time.

Tuna occasionally "run" in the waters around the proposed launch site, the tuna fishing boats in the area frequently follow these schools of fish. On occasions when the tuna are "running" in the waters surrounding the launch site, Sea Launch would delay planned launch activities until the boats have cleared the launch area.

We would welcome additional relevant data regarding fisheries activities in the proposed launch area. However, we remain confident in our finding regarding the potential for and non-significance of any impact to the fishing industry, its target fish stocks, and the ecosystem that supports the industry.

Health and Safety

Comment H1

- The Sea Launch EA notes that the Kiribati economy remains subsistence-based, and that the focus of the Kiribati people currently rests with the ocean fish stocks (Section 3.5.1). "Fishing from personal water craft, fish ponds and a relatively modern fishing fleet (first funded in the mid-1970s to meet the nutritional needs of the population) … now offer the greatest potential for income," the EA says. However, despite the possibility that one or more Kiribati fishing boats may be in the vicinity of any launch, there are no details of plans to alert the people of Kiribati before each launch.

[4] Personal communication with Bill Gibbons-Fly. NOAA Pacific Fishing Specialist.

***FAA Response*:** As discussed in response to Comments C3 and W2 and as is the case with all launches that we license, notice will be coordinated with various appropriate authorities before each launch to alert those who may be in the area to reduce the risk associated with falling debris. The details of the necessary notification of local fishing boats will be worked out in continuing discussions with the Kiribati government.

Comment H2

- The South Pacific Forum Fisheries Agency (FFA) has indicated a desire to support SPREP's comments particularly on this point of human safety, noting that scientific observers from the Secretariat for the Pacific Community (SPC) frequently work on fishing boats in the region and would like to avoid the risk of rocket debris falling out of the sky towards them.

***FAA Response*:** Please see the response to Comment H1.

Comment H3

- It is not stated in the document, in the event of an accident or failure during launch processes which result in significant injury to employees, what evacuation contingencies are planned other than a possible evacuation to Kiritimati Island, Kiribati.

***FAA Response*:** Detailed coordination to support the possible evacuation of people with medical emergencies through Kiritimati Island is in the initial planning stages by the Sea Launch Company. In general, people needing medical care would be flown to Kiritimati Island onboard the Sea Launch helicopter. The assembly and command ship (ACS) would be positioned closer to Kiritimati Island to shorten the distance the helicopter would need to travel over water. Simultaneously, Sea Launch would request dispatch of an aircraft from a contract service to support an airlift from Kiritimati Island. Discussions with Honolulu-based U.S. government resources are currently in progress to address more extensive contingencies.

Emergency evacuation of people through Kiritimati Island would also probably require the contracting of some services on the Island, e.g., overnight lodging, or the use of vehicles or supplies. Detailed discussions with the Government of Kiribati as currently being planned would identify in advance the need and availability of resources on the Island. Discussions will also address how Island resources could be augmented in consideration of the demands that may be placed on them by Sea Launch operations.

In addition, Sea Launch Company has begun to address possible non-medical contingencies that may arise during equipment malfunctions such as the delivery of spare parts or critical technical experts to the ships. These contingencies, and the options available to address them, will be the subject of upcoming meetings between the Sea Launch Company and the Government of Kiribati.

Comment H4

- As stated in the document under Social and Economic Considerations above, there may be a need to evacuate employees associated with launch activities to Kiritimati Island on an emergency basis. It is unclear what type of emergencies are envisaged. It is understood that Kiritimati Island currently does not have the capacity or infrastructure to deal with emergency evacuation cases of the nature as stated above. Transport services between Kiritimati Island and Honolulu are tenuous and currently service a predominantly tourist trade. A detailed evacuation contingency plan has not been provided, nor any indication of the contents of the Sea Launch System Safety Plan.

***FAA Response*:** Please see responses to Comments H3 and S2. Detailed operating and contingency plans are not usually incorporated into or appended to an environmental assessment but are rather referenced and available for review by appropriate authorities. We are confident, however, that discussions begun between the Government of Kiribati and Sea Launch Company and between Sea Launch Company and U.S. authorities will address necessary details regarding emergency evacuation and other contingencies.

Comment H5

- The safety aspects of a launch as stated by the document have outlined that the launch area has been located further west, to reduce dangers from falling debris away from the continental land mass. However, as identified in Section 4.3.4.2, falling debris poses a risk to a number of island land masses in the Galapagos group and the Galapagos island if, after assessment of "the first few launches"(Section 4.3.4) the flight path is reoriented to the south.

***FAA Response*:** We are charged with ensuring the safety of licensed commercial launches conducted by U.S. companies. As noted in response to Comment W3, we would view any change to the basic mission flight plan - including Galapagos Island overflights - as a change posing a potentially significant impact requiring additional our reevaluation of the adequacy of existing environmental documentation and potentially NEPA analysis.

Comment H6

- Whether the instantaneous impact speed decreases the dwell time over South America is unclear (Section 4.3.4) nevertheless the potential risk as the rocket traverses land remains.

***FAA Response*:** The information provided in EA section 4.3.4, second paragraph was intended to document the relative risk of rocket failure over South America and for any launch in general. As the terms are used in the space launch industry, a rocket's 'instantaneous impact speed' and 'dwell time' are inversely related. In other words, the faster the rocket's speed, the less time it needs to traverse (or dwell over) a constant measure on the earth below. Thus, as the rocket advances over South America, it would traverse more and more land surface with every passing second.

During the first Sea Launch launch, for example, the third stage would ignite 555 seconds after launch and burn continuously until 826 seconds after launch. The following table shows the number of seconds after launch at which flight over points of interest would occur, and the speed of the rocket at those same points.

	Seconds after Launch	***Rocket speed (km/sec)***	***IIP* Speed (km/sec)***
Galapagos Island	709	7.42	36
West Coast of South America	744	7.57	55
East Coast of South America	775	7.71	60
Orbital velocity beyond S. America		8.05	

* IIP = Instantaneous Impact Point

Thus, the risk of a failure over any point of land under a rocket is calculated second-by-second and is relative to the rocket's speed and the corresponding length of time spent over the area of interest on the earth's surface. In addition, historical data show the risk of hardware failure is substantially greater in those few seconds when the engines are turning on or off. Accordingly, we conclude that the risk of failure during the period of continual engine burn over the Galapagos and South America is correspondingly low.

Threatened and Endangered Species

Comment TE1

- Section 3.3 which describes the biological environment covered in the proposal states that scientific literature specific to the launch location and range is limited and that inferences have been made to assess the impact on fish, birds, mammals and reptiles.

***FAA Response*:** True.

Comment TE2

- The region served by the South Pacific Regional Environment Programme is situated in the middle of the largest continuous marine habitat on the planet, the Pacific Ocean. Marine mammals (whales, dolphins, porpoises, dugongs, and seals) range throughout much of this huge region. Of the world's approximately 120 living marine mammal species, three-quarters occur in the Pacific (*cf.* Rice, 1977a). Of the 90 or so Pacific species, perhaps a third are known to be resident in the SPREP region or at least to visit it seasonally or occasionally. Due to the vastness of the region and the relative lack of research activity in it, however, very little is known about the marine mammals in the SPREP region. Much of what is known about the distribution and seasonal occurrence of large whales has come from 19th century American, French and British commercial whalers (cf. Townsend, 1935) and from researchers working in conjunction with modern Japanese whaling operations (cf. Miyashita *et al.*, 1995a). Much of what is known about the smaller whales, dolphins and seals comes from the non-systematic, often opportunistic efforts of individual scientists. (Reeves et al.)

***FAA Response*:** We and Sea Launch recognize that the South Pacific region as a whole is a vast and diverse ecosystem that supports a wide variety of marine life. The available

data, however, support the conclusion that the specific areas potentially affected by the proposed launch activity on the periphery and east of the SPREP Convention area are relatively less populated by the species noted in the comment and less able to support the ecologically dense and diverse populations found in the SPREP region. We expect post-launch monitoring to confirm the preexisting data.

Comment TE3

- The document states there are no known threatened and endangered species that will be impacted by the proposed launch activities. It is known that two migratory threatened species inhabit these waters or nearby islands they being whales and marine sea turtles (Jefferson et al, 1993, Balazs, 1981). It is also recognized worldwide that although the open ocean can contain a low species diversity many species of migratory birds, mammals and reptiles move between land masses across these open waters. The conflicting statement made in Section 3.3 Paragraph 7 that a number of species of mammal, bird and reptile may traverse the proposal area but it is not crossed by a known migration route further emphasizes the lack of scientific knowledge that is available with which to make an accurate assessment of the impact of the proposal on threatened or endangered species.

***FAA Response*:** We believe the EA accurately and consistently summarizes available data. Briefly, the wide variety of migratory or highly mobile species that are known to pass through the east and central equatorial Pacific Ocean may traverse the areas associated with the proposed launch activity. The individuals of these species, however, would not be at risk of significant impact due to their relatively low concentration and transience in those areas, the only occasional presence of the proposed launch activity, and the extremely small area of the ocean affected by the activity. Please also see response to Comment W2.

Comment TE4

- The launch site is in the vicinity of a significant migratory fly-way associated with bird rookeries at Kiritimati Island. Impacts on this have not been properly assessed or addressed.

***FAA Response*:** Please see response to Comment TE3. We would welcome any additional available data on migratory birds in the area.

Comment TE5

- The impacts on diving and water-resting birds of the kerosene slicks that will result from rocket stage dumping have not been assessed.

FAA Response: The relatively brief presence and limited surface area of the kerosene would preclude a risk of significant impact to birds that might be in the area affected by the proposed launch activity and that would be vulnerable due to their feeding or resting behavior. Please also see response to Comment TE3.

Comment TE6

- It is recognised through their inclusion on the World Heritage List that the Galapagos Islands contain species which are both threatened and endangered (Carrasco, 1995). It has been stated that there is a potential risk of failure of the rocket therefore the fallout of debris poses increased danger to these species.

***FAA Response*:** The risk to Galapagos Islands' species would not be significant due to the extremely low probability of failure, the deviation to the north of the main islands for at least the first few launches - at which time new system reliability data would be assessed, as would the extremely small relative area that would be affected by surviving rocket hardware.

Relative Energy Efficiencies

Comment E1

- One of the environmental benefits mentioned in the Sea Launch EA is that fewer resources will be consumed and less pollution produced by launching from the equator compared to launches in higher latitudes. The resource consumption/waste production associated with transport to and from the launch site need to be factored into this equation.

***FAA Response*:** As part of the NEPA process, the Sea Launch EA was not intended to be a market analysis of the costs and benefits of the proposed launch system relative to other launch services. In this regard the marketplace of launch customers is expected to judge Sea Launch Company.

Environmental Management

Comment EM1

- There is no mention in the proposal that an environmental management system will be developed for the region in the vicinity of the launch site.

***FAA Response*:** The Sea Launch Company system for managing its environmental responsibilities is an integral part of its overall approach to managing safety. Please see response to Comment C5.

Comment EM2

- A comprehensive environmental monitoring programme should be developed for:

  - Marine water quality
  - Air quality
  - Underwater noise
  - Impacts on large marine animals including fish and marine mammals
  - Bird rookeries at Kiritimati Island

***FAA Response*:** We and Sea Launch invite comment and technical input regarding study methodology on the following monitoring elements. Proposed elements are based on probability of harm or measurable effect to the environment that may be expected from the proposed launch activity. We will make the monitoring results available for review and arrange for their direct distribution to interested governments, government bodies, and scientists.

1. Launch area visual observation - periodic visual observation and recording from the bridges of both vessels (including the Launch Platform while manned) of number, sex, maturity and condition of mammal, reptile, bird, and fish individuals present in the vicinity of the launch platform immediately prior to, during, and following each launch.

2. Exhaust trail survey – high-resolution survey by Doppler weather radar of physical atmospheric processes during recovery of the hole made by the rocket and emission dispersion.

"Vessel of Opportunity" Research Ideas for Consideration

1. Sea Launch could offer data tapes from its oceanographic data buoy and Doppler weather radar surveys during each mission to interested atmospheric processes researchers.

2. Sea Launch could provide a 'guest scientist' with a berth after the first or second launch to coordinate and conduct scientific research that is consistent with mission success.

3. Sea Launch could adopt a grade school class(es) to plan and conduct science experiments under the direction of the 'guest scientist.'

Cumulative Impacts

Comment CI1

- The document states in the context of cumulative impacts that there will be no other foreseeable planned development in the area of the proposed launch location at this time. SPREP however views the context of cumulative impacts over the anticipated twenty (20) year life expectancy of the proposal as being:

  - the amount of randomly dumped debris (rocket stages, fairings);
  - the amount of emissions (greenhouse gases and ozone depleting substances);
  - the amount of ocean contamination (kerosene and other fuels); and
  - the level of mortality of biodiversity (plankton, marine and bird species)

***FAA Response*:** Please see responses to Comments addressing these specific cumulative aspects (i.e., Comment W2; Comments A3, A5, A6, and A7; Comment W1; and Comment B4).

Pacific Policy Issues

Comment P1

- The people of the Pacific region are guardians of their ocean resources. Their socio-religious lifestyles previously dictated very strong cultural ties to their natural resources. In this context although the document states there will be no significant impact of the launch activities to archaeological and cultural resources, it remains the view of SPREP that potentially there could be significant impacts to the Pacific peoples' cultural resources.

***FAA Response*:** In reaching the proposed conclusions documented in the Sea Launch EA on this subject, we considered the record of economic development projects that either have been endorsed or are currently receiving serious and positive consideration by SPREP and many nations in the region. Given this broader context, in the course of discussions initiated between the Government of Kiribati and Sea Launch, the government will have the opportunity to minimize any significant negative impacts to the peoples of the Pacific or their cultural heritage. We believe discussions will demonstrate the proposed Sea Launch activity would be highly compatible with the expressed socio-economic aims of the people in the region, and it would be viewed over time as a significant and positive benefit to the Government and People of Kiribati.

Comment P2

- Pacific island countries have taken the stance in regional and international fora that the Pacific should not to be used as a dumping ground. This fundamental philosophy is directly at variance with the Sea Launch proposal, which appears to have selected its Pacific ocean site largely because it is a remote location far from population centres.

***FAA Response*:** EA Section 2 clearly states the opposite conclusion - that Sea Launch Company evaluated numerous launch locations and selected the area some distance to the east of Kiritimati Island precisely because that location appeared to maximize the safety of people and the environment. In its parallel and overarching assessment, we took into account that all launches licensed by nations throughout the world – many of which are conducted in the Pacific region – pose comparable or arguably greater risks to the people and the environment. We concluded the Sea Launch proposal compared favorably in this regard. The Sea Launch proposed project would comply with MARPOL maritime disposal standards and all other standards in applicable treaties (EA Appendix B).

Additional References

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Jefferson, T.A., Leatherwood, S. and Webber, M.A (1993) *Marine Mammals of the World*. UNEP, FAO. Rome.

Miyushita, T.; Kato, H. and Kasuya,T. (1995a) *World wide map of cetacean distribution based on Japanese sighting date (Volume 1).* National Research Institute of Far Seas Fisheries, Shizuoka, Japan.

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Rice, D.W.; (1977a) *A list of the marine mammals of the world*. NOAA Technical Report NMFS SSRF-711

Townsend, C.H. (1935) *The distribution of certain whales as shown by logbook records of American whaleships*. Zoologica 19(1-2) 1-50+maps.

National Oceanic and Atmospheric Administration

Comment 1

- The proposed project may have some minor impacts on NOAA trust resources and we suggest that FAA consider including mitigation measures which include monitoring of the area around the site before and after each launch.

FAA Response: An Environmental Monitoring and Protection Plan is being developed as an integral part of Sea Launch plans for operations at sea, and its implementation involves the participation of both aerospace and marine crews. Proposed monitoring elements are based on probability of harm or measurable effect to the environment that may be expected from the proposed launch activity. The monitoring results are expected to be made available for review through the FAA as well as by direct distribution to interested governments, government bodies, and scientists.

- Launch area visual observation – hourly visual observation and recording from the bridges of both vessels during daylight (including the Launch Platform while manned) of number, sex, maturity, and condition of mammal, reptile, bird, and fish individuals present in the vicinity of the launch platform immediately prior to, during, and following each launch.

- Exhaust trail survey – high-resolution survey by Doppler weather radar of physical atmospheric processes during recovery of the hole made by the rocket and emission dispersion.

- Water sampling - surface water samples near the Launch Platform will be taken before and after the Launch. Several research ideas for consideration can be proposed to use Sea Launch presence at the launch site for scientific research. The sampling plan will be developed with an emphasis on personnel safety.

- Data tapes from Sea Launch oceanographic data buoy and Doppler weather radar surveys during each mission offered to interested atmospheric processes researchers.

- A ‘guest scientist’ could be provided with a berth after the first or second launch to afford the opportunity to coordinate and conduct scientific research on the condition that it is consistent with mission success.

- Adopt a grade school class to plan and conduct science experiments under the direction of the ‘guest scientist’.

Comment 2

- The one area of the EA that could have used additional information is the description of the biological resources located in the general area of the launch site.

FAA Response: The FAA recognizes that the South Pacific region as a whole is a vast and diverse ecosystem that supports a wide variety of marine life. The available data, however, support the conclusion that the specific areas potentially affected by the proposed launch activity on the periphery and east of the SPREP convention area are relatively less populated by marine mammals such as whales, dolphins, porpoises, dugongs, and seals and less able to support the ecologically dense and diverse populations found in the SPREP region. Monitoring at the launch location is expected to confirm the preexisting data.

Comment 3

- Although the EA contains a short description of the biological environment surrounding the launch site, the information provided is primarily a description of lower trophic levels such as marine plankton and there is very little discussion of fish stocks or marine mammal populations found within the area. In particular, the statement that no endangered species are located in the area may be incorrect as several species of endangered and threatened large whales and endangered sea turtles are found throughout the region.

FAA Response: As noted in the preceding comment, the FAA and Sea Launch acknowledge the wide variety of marine life that inhabits the Pacific Ocean. Fish stocks are distributed throughout the Pacific region and are not concentrated in any one location. Fishing fleets from several countries, including the United States, are spread throughout the Central and Eastern portions of the region. As there are no known fishing fleets that specifically consistently fish in the vicinity of the proposed Sea Launch site, it is presumed that there is not a great density of fish in the area.[5]

Numerous marine mammals are present in the Pacific Ocean including whales, dolphin, seals, and sea turtles. None of these species are known to exclusively inhabit the proposed launch site.[6] While the possibility exists that marine mammals might enter the area during launch operations, visual inspections performed prior to launch would identify the mammal and its location and the launch would be delayed until it is out of harms way.

Comment 4

- While the project itself may pose only minor impacts to marine resources, the EA could be improved if additional information was included on the impacts of short term exposure to kerosene to both marine mammals and large pelagic fish which are found near the sea surface.

FAA Response: Organisms such as fish and marine mammals living in the open ocean are not expected to be harmed by the small amounts of kerosene released by the Sea Launch project. Generally, these organisms avoid open water spills by going deeper in the water or around the edge of the spill. Marine mammals that live closer to shore, such

[5] Personal communication with Mr. Bill Gibbons-Fly, NOAA Pacific Fishing Specialist

[6] Personal communication with Dr. Beth Flint, US Department of the Interior, Fish and Wildlife Services, Hawaiian and Pacific Islands NWR Complex

as turtles, seals, and dolphins could be impacted by a kerosene spill near the shore, however, the kerosene from the spent stages would not be released near or travel to any coastline.[7]

Comment 5

- Another possible impact of the proposed project would be a short disruption in commercial fishing activities in the immediate launch area prior to the launch. This area of the Pacific does receive some commercial fishing effort from the U.S. fishing fleet, particularly vessels out of Hawaii and U.S. Trust Territories fishing for large pelagic fish like yellowfin and albacore tuna. To avoid any disruption in fishing activity we would suggest that an advance notice to mariners be sent to U.S. vessels as soon as a launch date and time is scheduled.

FAA Response: Commercial launch operators throughout the world currently coordinate with affected governments and organizations to provide safety notices prior to each launch. For launches conducted under FAA authority, Notices to Mariners and Aviators are handled for all regions affected through the United States Coast Guard and our Central Altitude Reservation Function, respectively. Additionally, no launches would be conducted unless all fishing vessels are clear of the predetermined safety zone surrounding the Launch Platform. Visual and radar sensors will be used to verify this. The administrative details involved with issuing these notices will be worked out with the appropriate authorities.

Section 4.5.5 of the EA, "Coordination with Vessel and Air Traffic," indicates that Sea Launch would provide all necessary warnings to mariners and aviators potentially affected by its launch activity. In addition, several months before the first launch, Sea Launch Company intends to work with the Republic of Kiribati and representatives of industrial fishing fleets that operate in the region to coordinate the administrative process by which such notice would be given. Sea Launch Company would also like to work with SPREP and other appropriate groups in identifying how best to notify local fishing vessels.

Comment 6

- To avoid any possibility of interaction with marine mammals we suggest that FAA consider including some mitigation measures with the proposed project that include monitoring before and after each launch.

FAA Response: Hourly visual observations from the bridges of the M/V Commander and the M/V Odyssey (when manned) and from helicopter when the M/V Odyssey is under remote control is planned to note and attempt identification of any species of interest that might enter the area prior to a launch. Records will be kept of the number of individuals observed, the proximity to and duration in the observation area, and the creatures behavior, bearing, and speed. If the individual is expected to be within 100 meters or so of the M/V Odyssey during rocket ignition, the launch would be delayed

[7] *Sensitivity of Marine Habitats,* U.S. Environmental Protection Agency, Oil Spill Program, Web site www.epa.gov/oerrpage/oilspill/habitats.html.

until it had left the area. Observations of mammals outside the 100 meter area would continue throughout the launch period and after launch to determine any behavior differences that might be caused by the Sea Launch operations.

Comment 7

- A monitoring program which included overflights before and after each launch would reduce the possibility of marine mammal interactions and provide additional information on any long term impacts to the surrounding marine environment.

FAA Response: Please see response Part A above.

Government of Australia[8]

Comment 1

- Zenit-3SL is not the best available technology.

FAA Response: The Zenit-3SL is the most advanced kerosene-liquid oxygen propulsion launch system in the global launch industry today. This is demonstrated by the fact that the Zenit-3SL and other systems produced by the Commonwealth of Independent States (CIS) are frequently selected by satellite launch operators and customers for use on performance, reliability, and cost criteria. This is particularly true regarding the engines, which are selected by launch providers throughout the world to place their satellite payloads in orbit. The launch industry in Russia and Ukraine is also responsible for developing an innovative design for the horizontal integration and handling and the automated pre-launch processing of the Zenit launch vehicle. These fundamental improvements – unprecedented for a rocket of its size - greatly reduce the number of people involved with the more hazardous steps in the process.

In addition, the kerosene-liquid oxygen propellant combination is considered to be equivalent or superior to alternative propellant systems in terms of safety for people and the environment, although there are pros and cons to any propellant system. For example, a liquid oxygen and liquid hydrogen system burns cleanly, but imposes additional risks to people and operational constraints. Hypergolic systems, in which the fuel and oxidizer ignite spontaneously when in contact with each other, and solid propellant systems provide good performance characteristics, but each impose their own safety, operational and emission concerns and constraints.

Thus, each launch system has advantages and disadvantages. In any event, we note that under NEPA the Environmental Documentation is required to inform decision makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the human environment. The Zenit – 3SL is the best available technology that meets the requirements for this project.

Comment 2

- Is Sea Launch meeting United States oil rig disposal standards with regards to flushing of the kerosene lines? And should stationary oil platform standards apply to Sea Launch?

FAA Response: Flushing kerosene lines is not performed as a normal operating procedure on the Launch Platform after fueling a launch vehicle, but only occurs in the unlikely event of an unsuccessful ignition attempt during launch. An unsuccessful ignition attempt would result in an automatic de-coupling of the fuel lines, resulting in the release of approximately 70 kg of kerosene. The structural members of the flame bucket are expected to contain the kerosene, although a small portion could splash over

[8] No formal written comments were received from the Government of Australia, these responses are based on conversations with Australian representatives.

and reach the ocean surface. It is estimated that this defueling would occur only once every 87,000 launches.

When the Launch Platform is on location for a launch in the equatorial Pacific Ocean, it could be construed to be a stationary platform. The applicability of various U.S. and international standards appropriate to stationary oil platforms were considered, including the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), the Act to Prevent Pollution from Ships (33 USC 1901-1911), and the Oil Pollution Act of 1990 (OPA 90).

Under the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), a discharge of any amount of kerosene would be prohibited (Regulation 21) and therefore subject to the reporting requirements outlined in Article 2 (6). In the unlikely event that the kerosene is released, Sea Launch would promptly report the incident in compliance with MARPOL requirements. As discussed in the EA, a discharge of this nature would have only minor and temporary effects on the surrounding surface waters.

The proposed Sea launch activities at the launch site do not come under the jurisdiction of the Act to Prevent Pollution from Ships, 33 USC 1901-1911, as the Launch Platform is flying under a Liberian flag in international waters..

The Oil Pollution Act of 1990 (OPA 90), Section 1002 regulates discharges that occur into or upon the navigable waters, adjoining shorelines, or within the exclusive economic zone of the United States. As Sea Launch will be launching from international waters, Section 1002 does not apply. Section 1007 addresses claims for discharges of oil in or on the territorial sea, internal waters, or adjacent shoreline of a foreign country. The Launch Platform will be located 544 nautical miles outside the territorial sea, and outside the exclusive economic zone of Kiribati and is therefore not subject to the requirements of Section 1007.